

# Efficient and environmental solutions of shale gas exploitation

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Zhang, Mi

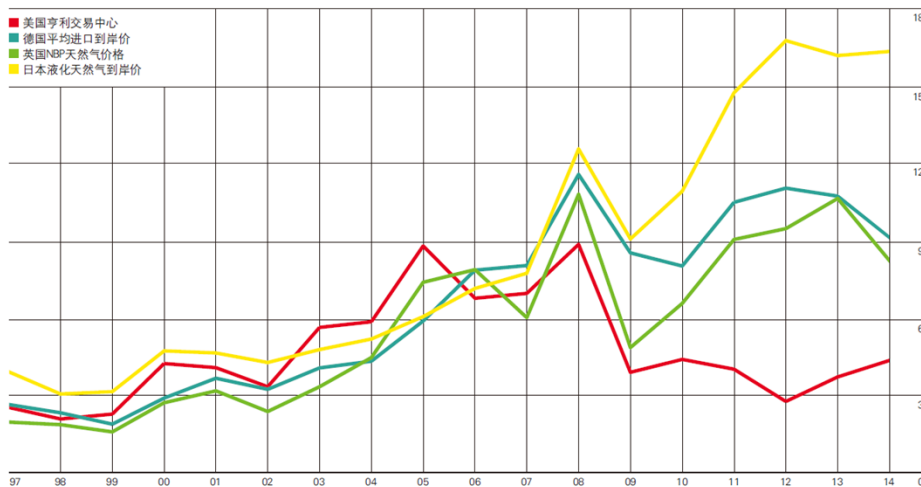


一、 Confusions and challenges confronted in commercialized shale gas exploitation of China

二、 Efficient and environmental solutions of shale gas exploitation.

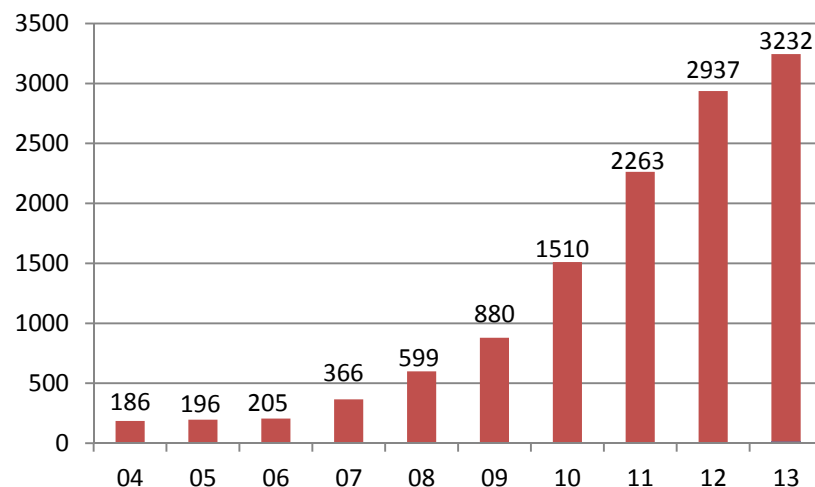
# The success of the U.S. shale gas revolution has far-reaching impact

## U.S. shale gas production rose sharply causing a sharp decline in U.S. natural gas prices



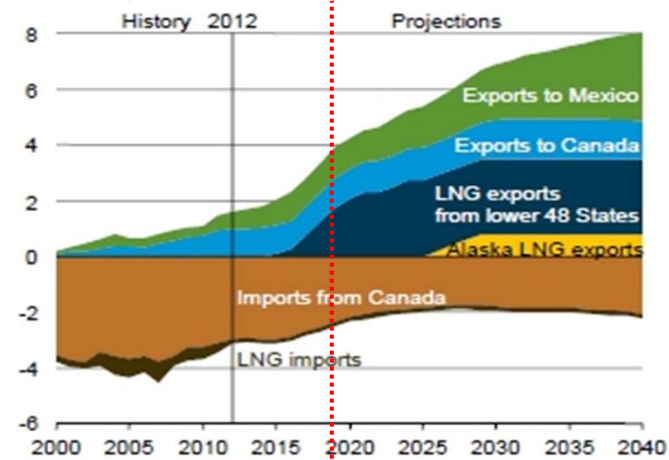
(Source : Statistical Review of World Energy 2015 )

## U.S. shale gas production from 2004 to 2013



(Source : EIA )

## United States will become a net exporter of natural gas in 2018



The success of the U.S. shale gas revolution, makes the United States obtain a large number of long-term, low-cost, clean energy. Furtherance :

- Better energy structure;
- Energy independence;
- Manufacturing regression;
- Foreign policy is more flexible

# Confusions and challenges confronted in commercialized shale gas exploitation of China



resource  
?

**Sichuan Basin:** Marine shale gas favorable area in Longmaxi formation where have achieved breakthrough is 75,000km<sup>2</sup>. The geological resources is 25 trillion cubic meters, and the recoverable resources is 3.7 trillion cubic meters. There are 35,000km<sup>2</sup> of shale gas resources are more favorable, geological resources nearly reached 14 trillion cubic meters, recoverable resources is about 2.8 trillion cubic meters.

Economy ?

**Changning-Weiyuan Block :** As of August 18, 2015, 47 wells has been put into operation in Changning - Weiyuan shale gas demonstration zone. 22 wells has been put into operation in Changning, 2360000 m<sup>3</sup> per day; 25 wells has been put into operation in Weiyuan, 1260000 m<sup>3</sup> per day .

**Fuling :** As of Aug. 30, 2015, Fuling shale gas field has accumulated a total of 246 wells drilled, put into operation 119, 12000000 m<sup>3</sup> per day .

Technology  
?

The breakthrough of scale production of shale gas depends on the advanced horizontal drilling and hydraulic fracturing technology. These two key technologies are already widely used in our conventional drilling operation.

water  
deprivation  
?

shale gas is calculated as 279.81MMBtu per cubic meters, 20% purification rate; on average 1 ton water may produce 4000m<sup>3</sup> shale gas



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    陆上常规气 --> 运输储存([运输储存])
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资源

勘探生产

陆上常规气

页岩气等非常规

深海气

运输储存

地下储气库

骨干管网

液化与存储

LNG 运输

接收、存储、再气化

配送

直供用户

配气管网

储气设施

终端用户

油气勘探开发服务

管网与输运存储设备制造; LNG 船、接收站、加注站、LNG 汽车

配气、管网、储气设施, 调压仪表等

No quantity and price guarantee for gas user.

# Confusions and challenges confronted in commercialized shale gas exploitation of China

China's natural gas development is lagging behind

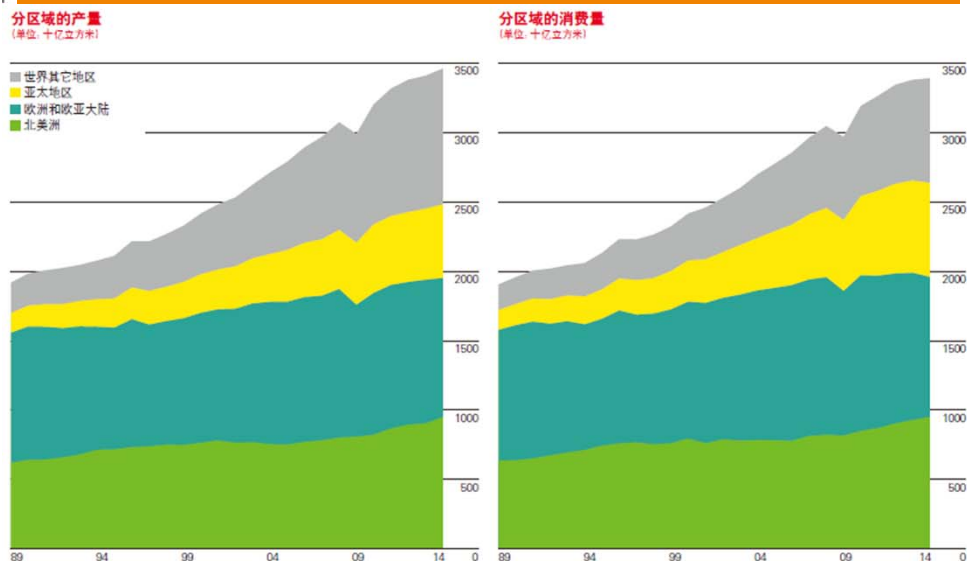
U.S., 2014, natural gas production 728BCM, consumption 759BCM。

China, 2014, 234BCM, consumption 185BCM。

( Source : Statistical Review of World Energy 2015 )

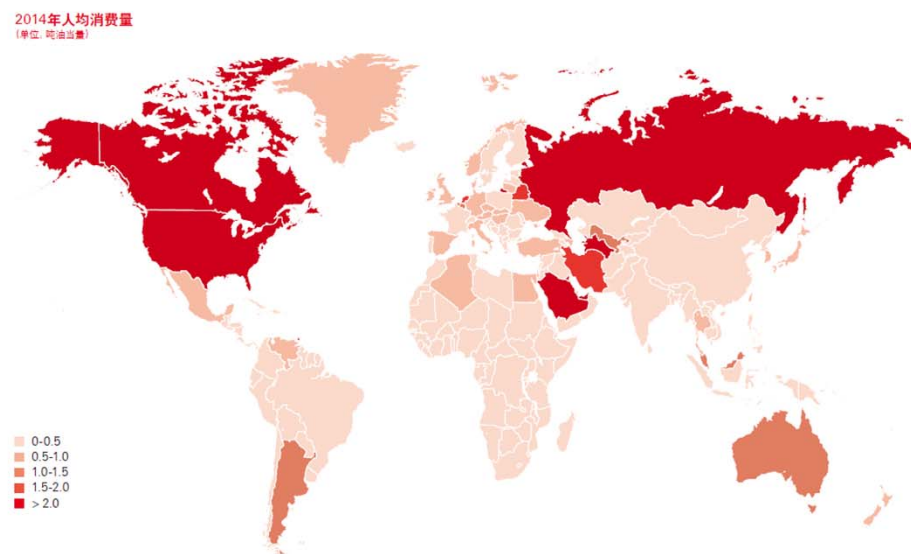
China's natural gas price is 4 times more than that of the United States.  
Compared to U.S., China only can consume no more than  $\frac{1}{4}$  natural gas with the same money

Natural gas production and consumption in 2014



( Source : Statistical Review of World Energy 2015 )

2014 global per capita consumption of natural gas



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二、 Efficient and environmental solutions of shale gas exploitation.

## Integrated solution for Shale gas by Honghua

Based on the overall requirements, effective environmental exploitation requests an integral planning with a sincere consideration of cost efficiency, paramount technology employment, possibility of utilization of well gas and optimized site map planning, etc. Therefore, HH presents below:

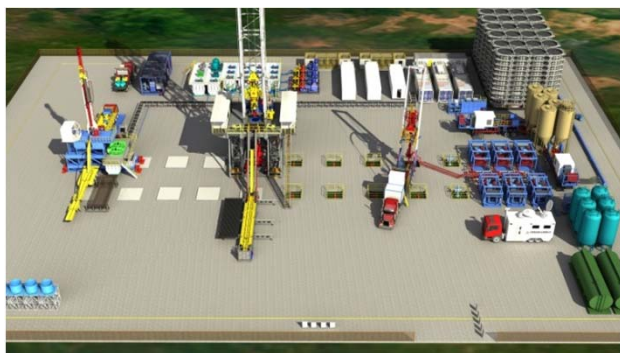
### 1. Optimized site mapping



### 2. Utilization of well gas



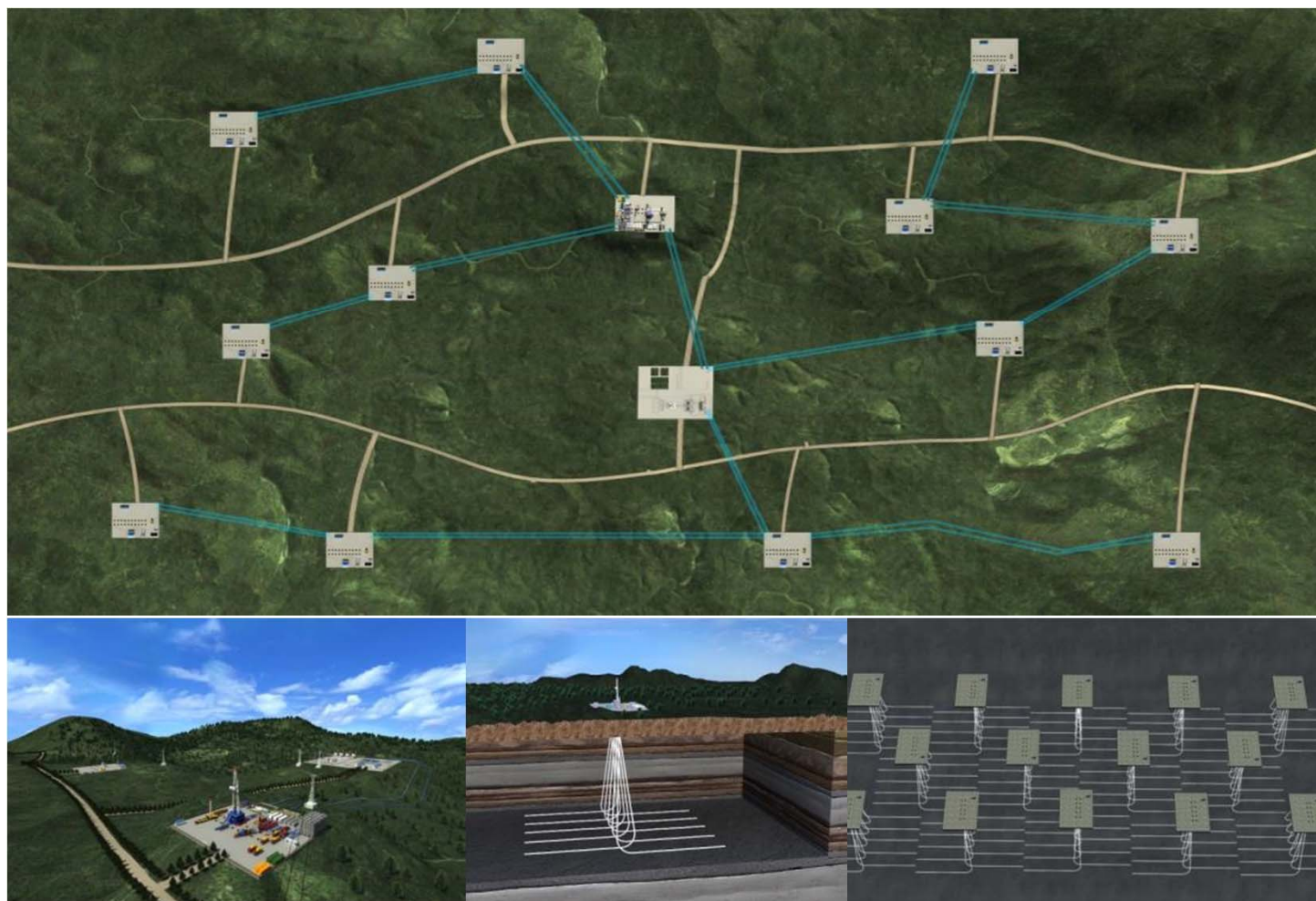
### 3. Integrated drilling operation



Fixed-asset investment reduced by 10%;  
Land occupation reduced by 20%-40%  
Numbers of operator reduced by 30%-40%;  
Fuel costs reduced by 20%-40% ;  
Drilling and completion cycle reduced by 30% ;  
Reduce overall exploitation cost by 10%;  
Diesel saving 400Tons for one well;

## Optimized integral solution proposal

HH's proposal would comprise a 50,000kW power station, 10 drilling rigs , 2 sets of fracturing fleet. With these set up, operation will be able to accomplish 50 wells (drilling and completion) per year, include 15 ~ 20 rig sites and cover the size of area approx. 120 ~ 150 km<sup>2</sup>.



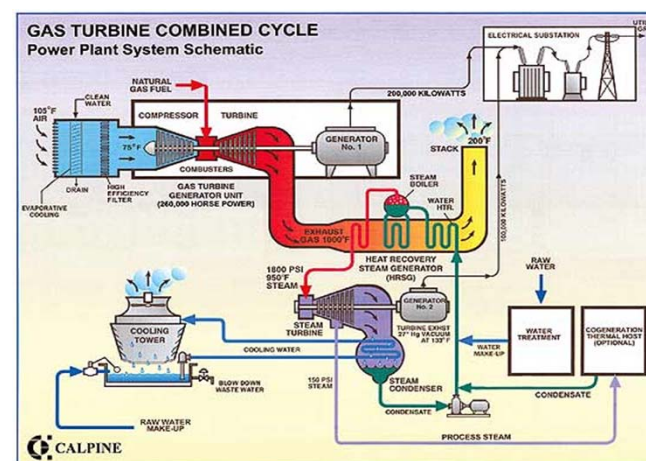
# Gas power station contributes enormous benefits

The gas power station consists of combined cycle gas turbines, through it, which provides heat efficiency up to 70%.

Power stations would better be set up near residential areas to have easy access to the national power grids. It is cost-effective to use cheap hydroelectric power in Sichuan.



Centralized gas power station



Gas power generation working schematic

# Drilling solutions



In recent years, HH has supplied nearly 60ea land rigs to serve in US shale gas drilling industry. Honghua is known as a prime drilling equipment manufacture with extreme rich experiences in technology innovation and supplying customized drilling packages to satisfy our customers' requirement. Honghua is competent not only to provide high efficient drilling equipment but also to integrate it along with advanced downhole technology or tools to help our customers achieve desired performance and profit in sale gas exploitation.



1500/2000HP beyond rig

Automatic AC rig  
Pad drilling  
Pipe handling system, 5-6 rig operators  
needed only  
Idrill system



2400HP Quintuple Mud Pump



Top driver



Rotary steerable system, LWD and oil-based drilling mud can realize long horizontal section

## Configuration of the drilling for Sichuan-Chongqing zone



# Well completion and fracturing solution

Honghua has innovated electric drive fracturing equipment including the world's biggest horse power fracturing pump. Such innovation has Effectively resolved the bottleneck of the traditional diesel fracturing equipment in shale gas drilling. It offers significant benefits in reducing the size of area that the equipment usually uses up, freeing more field hands, fuel cost savings, helping environmental concerns, etc.



6000HP AC Fracturing pump



Coiled tubing equipment

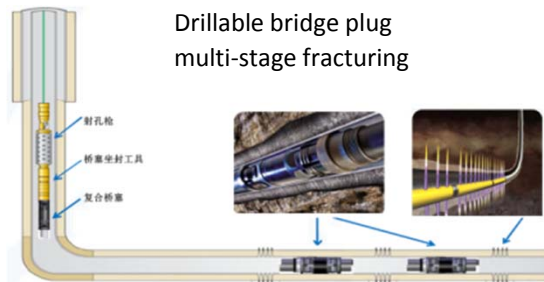
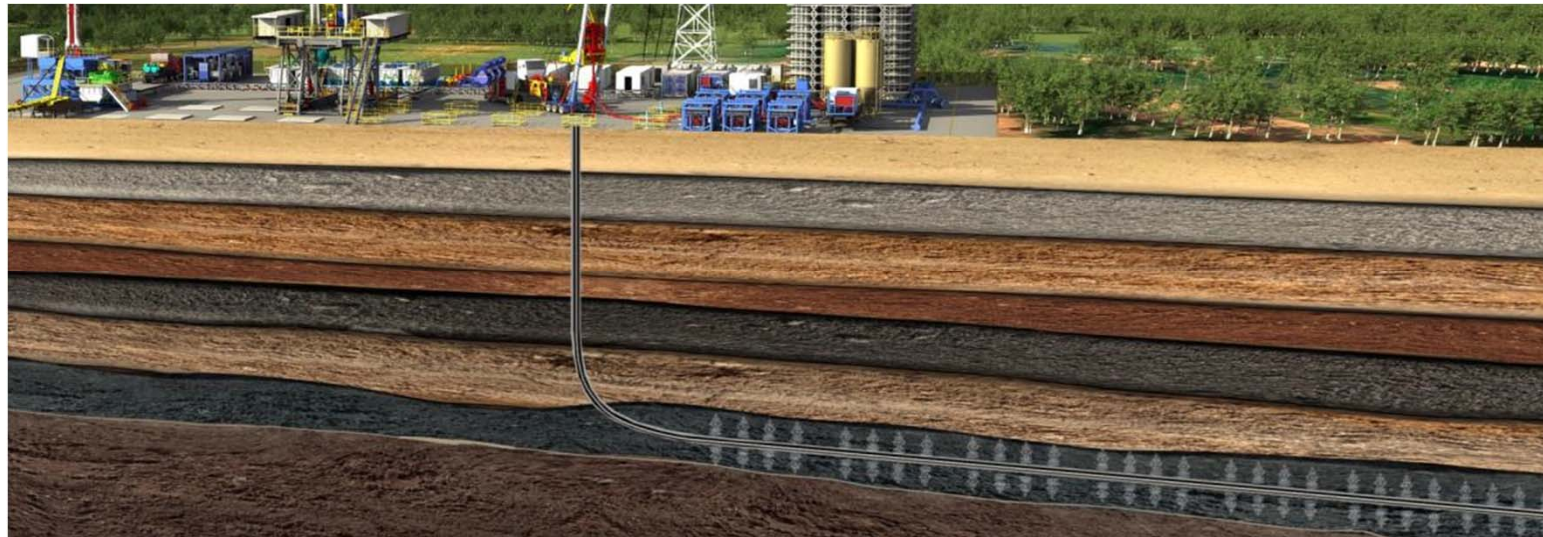


Automatic fracturing blender system

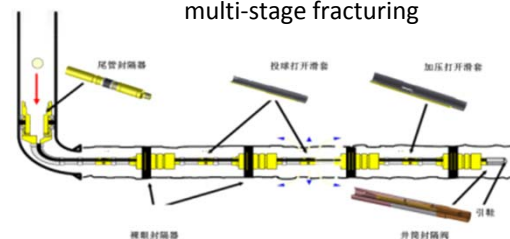


Flexible water tank

- At least Half operator
- Half land occupation

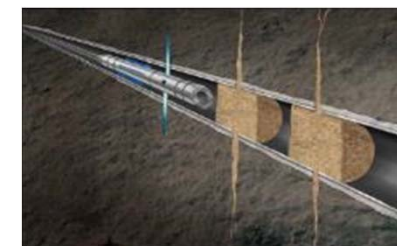


Drillable bridge plug multi-stage fracturing



The sliding sleeve packer multi-stage fracturing

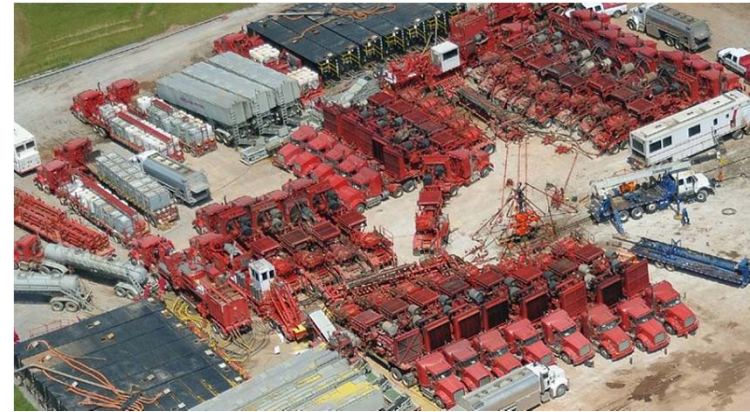
Hydraulic sandblasting multi-stage fracturing



## Configuration of the fracturing for Sichuan-Chongqing zone



## Electric Fracturing Equipment with high horse power makes sites more compact



= 3×



There are thousands of sales gas wells being drilled in China annually. The need of fracturing equipment for such operation is getting close to 10000000 horsepower, equivalent to 4000 diesel driven fracturing units. Abide by the governmental regulation to the low carbon environmental protection requirements, the use of large power diesel engines will be significantly reduced. 6ea of HH innovated 6000HP electric fracturing pump is able to replace 18ea of conventional fracturing units, also meeting the same requirements of fracturing operation.

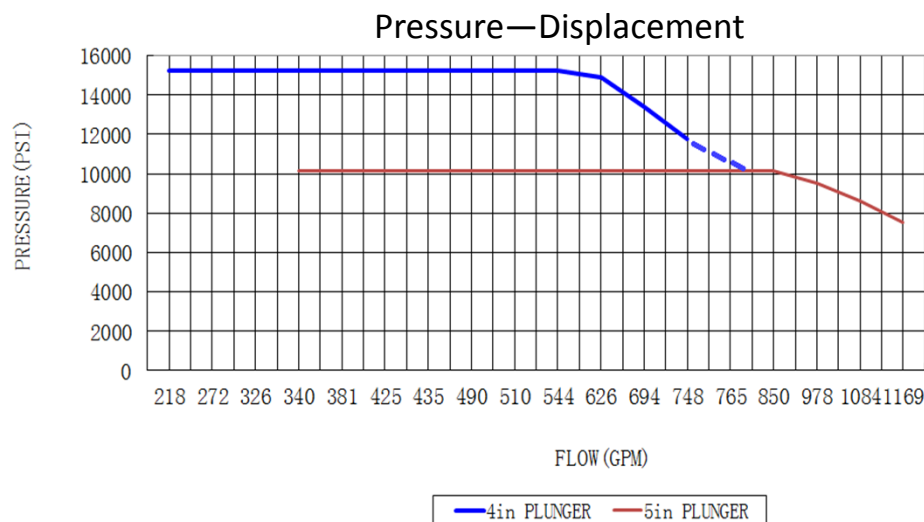
# 6000HP Electric Fracturing Pump



Max. Input Power	6000 HP (4500 kW)
Max. pump stroke	275 SPM
Stroke	254 mm
Gear ratio	4.516 : 1
Max. Force of rod	940kN(211310 lb )
Max. pressure	105Mpa(101.6mm plunger )
Max. displacement	4.42 m <sup>3</sup> /min (127mm plunger )
Displacement under 75Mpa	3.49m <sup>3</sup> /min ( 216SPM )
Displacement under 105Mpa	2.30 m <sup>3</sup> /min ( 225SPM )
Dimension(mm)	6175 X2990 X3030
Weight	32t

## Features

- Power rated as the largest fracturing pump in the world, the first pump is driven by medium voltage frequency AC motor
- Reduces the numbers of pump units in a fleet, compact space usage, high horse power rated, logistic efficiency.



## Centralized water treatment to work environmental friendly



Return water collection and pumping



Central power station with sewage disposal system

Drilling wastewater and fracturing wastewater will be collected and transported to Central station by pipe for centralized water treatment. The treated water will be returned to well site for drilling and fracturing purpose . This water solution would possibly reduce approx. 20-30% water usage and lower the cost for waste water treatment as well.

## Zero discharge, noise pollution control



Fully Electric and sound proof equipment



Sound proof walls around shale gas play in Barnett

Make “24hours work” possible

No diesel, zero nitride emission. Centralized waste treatment solution is meeting zero discharge requirement.

By using fully electric equipment , the sound control can be realized below 80 dB on the drilling site and below 70dB 50m distant away from the site.

Fully water cooling electric equipment , and sound proof walls can be considered when environmental requirement is even more strict. Which can realize the sound below 70dB 1m distant away from the site.

## Test in factory



- HH have accomplished no-load testing, load testing and high power testing for 2 sets of fracturing skid(5in plunger), max testing power reach 4500kw ( 6000hp ) , and running with actually 5hrs at the condition of 4000kw(90pct of the rated data); also accomplished 4in fluid end high power testing, running with 5hrs at the condition of 224spm and 105mpa.
- HH have accomplished continuous running testing for 2 sets of fracturing skid(4in fluid end), running with 4hrs at the condition of 80mpa,6000kw, to certify reliability of the whole devices including generating and controlling system.
- Have successfully accomplished electrical safety valve testing(totaled 4 times).
- Totaled field testing more than 100hrs

## Industry test



- HH have completed industry testing for 2 sets of the fracturing skid located in California, USA, finished cluster wells fracturing operations for 12 wells(45 phases), keep good condition presently.
- Also to go on pre-assembly 2 sets of the fracturing skid in HH factory, and plan to send to the Guanghan Sylvine project( on the condition of 80Mpa, displacement with 2 square/min)

## Oil service



- In 2013, HH service had accomplished the very first shale gas drilling contract in China and received a sincere compliment from our customer.
- In 2014, we have 7 rigs are dedicated to drill shale gas at the moment in China.

- As of December 31, 2014, 14 horizontal wells have been completed. The success rate of is 100% for drilling and casing.
- The Horizontal section of well YS108H6-6 is 2005m, which is the longest in Sichuan.

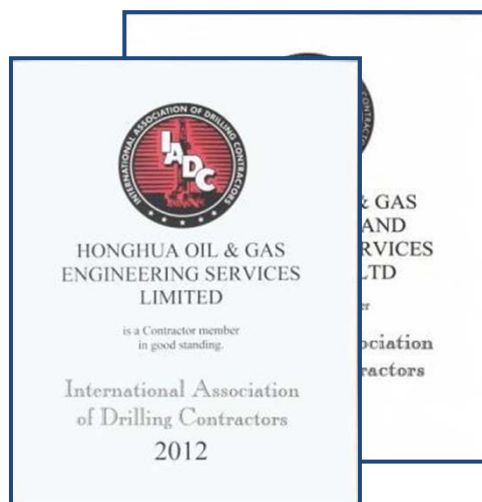


## Honghua is devoted to China Shale gas

As a member of IADC, HH provides customers with turnkey service.

Currently, HH service has 1,300 employee on staff composing 23 drilling teams, 30 mud teams, 10 directional drilling teams.

When China entered the stage of large-scale shale gas production, Honghua oil service can become a powerful complement to the State-owned enterprises, is expected to achieve the ability to drill and completion of more than 200 wells per year.



We are waiting for:

The shale gas in China develop rapidly.  
China has become the second bright spot  
in the development of shale gas

