



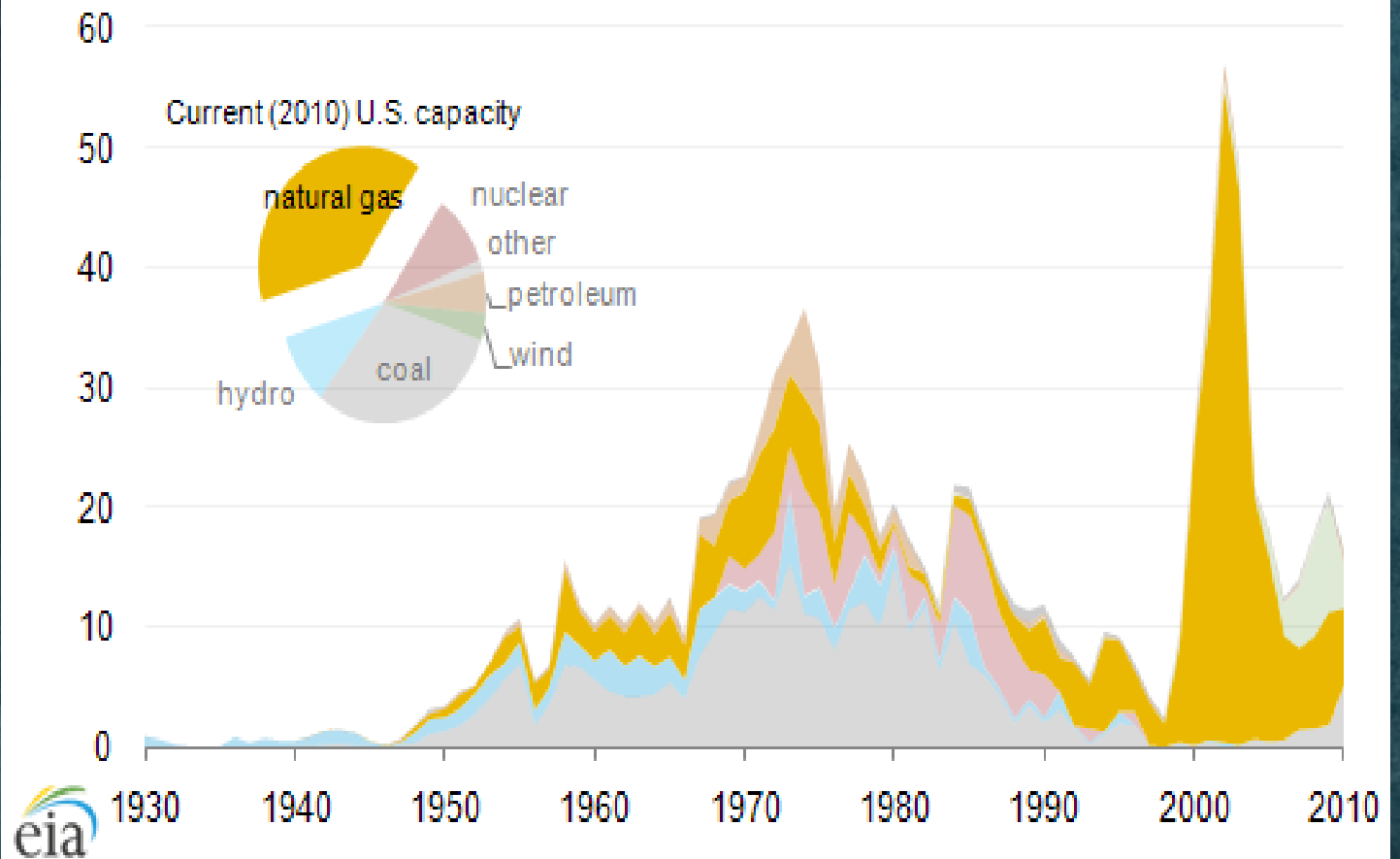
For more than 20 years,  
HRSGs have been designed  
and operating with little to no  
long term maintenance – what  
will trouble you and how could  
you have seen it coming?

Presenting...

## Strategic and Financial Planning For HRSG Maintenance



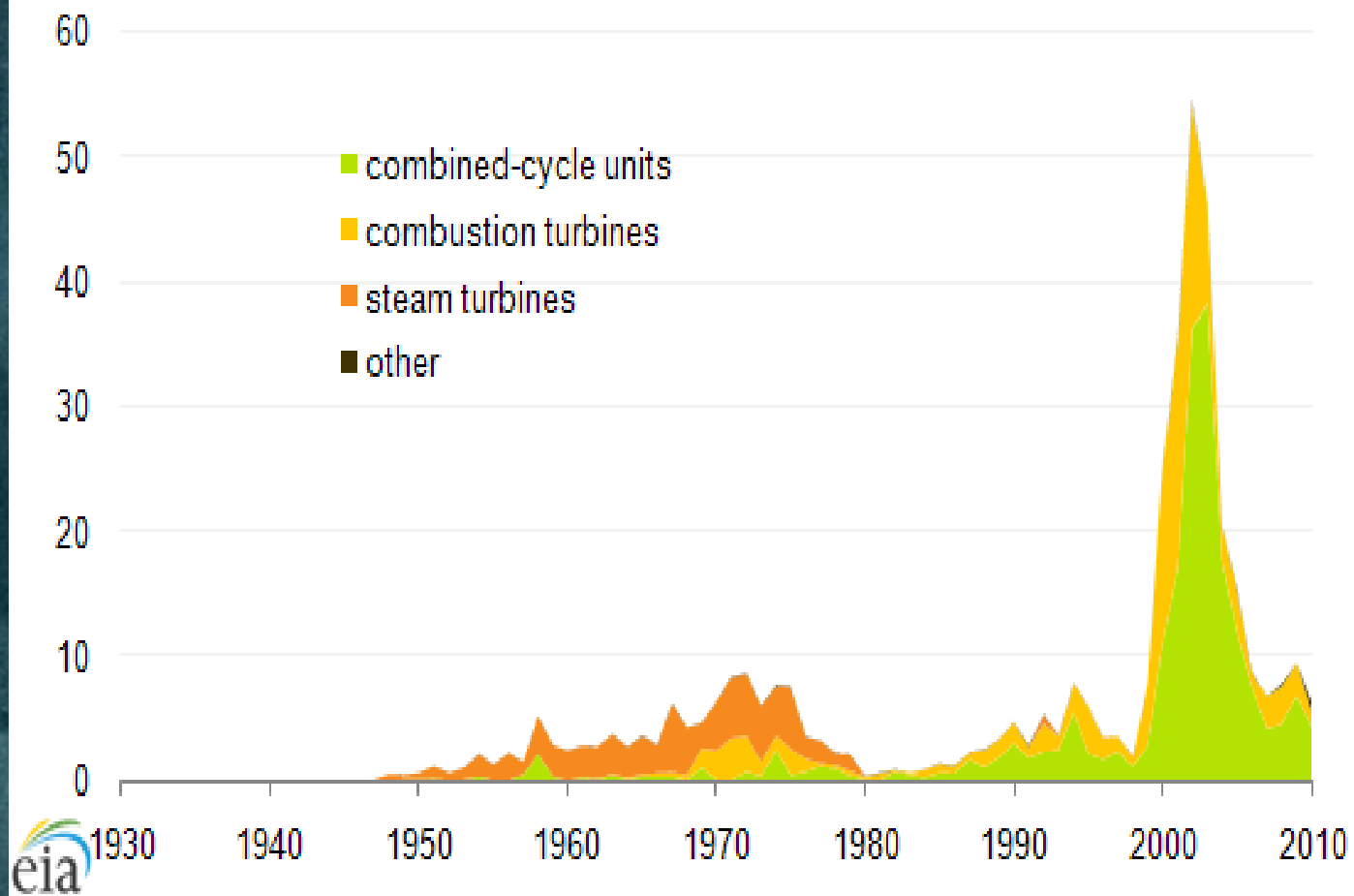
### Current (2010) capacity by initial year of operation and fuel type gigawatts



Source: EIA Table ES3 March 2011 EPM



Current (2010) capacity of natural gas generators, by initial year of operation and type gigawatts

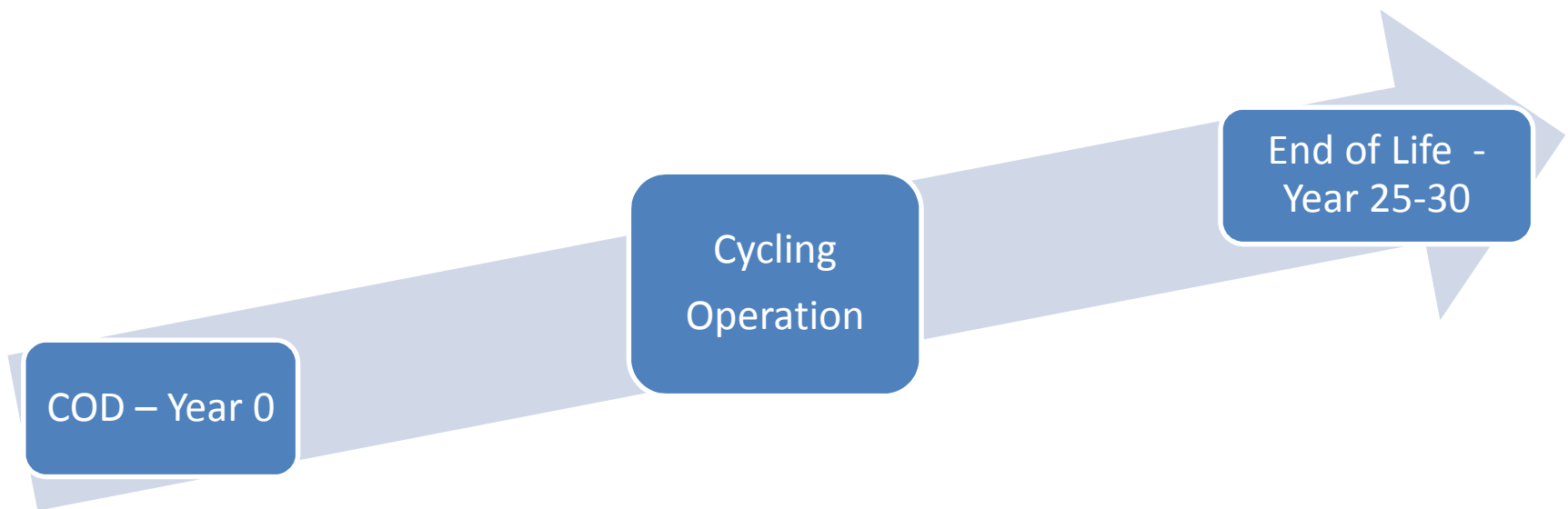


Source: EIA Table ES3 March 2011 EPM



## Design Life – What is the determining factor?

- EPC Contract
- Base Load vs. Cycling



New Ownership

High Energy Piping Program (HEP)

9% Chrome Issues?

Spin Cooling

Cycling Effects?

Fast Start

Personnel Change

FAC Risk Assessment





YOU KNOW WHY "SHREK" IS THE BEST FAIRYTALE?  
CAUSE IN SOME FAIRYTALES, THE PRINCES AND  
THE PRINCESSES ARE PERFECT. BUT IN SHREK IT  
TEACHES US THAT IMPERFECT PEOPLE CAN STILL HAVE  
THEIR OWN HAPPY ENDINGS.

NO BUSTERS via 9DAG.COM

People are imperfect – they will:

- Say the wrong thing
- Misinterpret
- Mix things up
- Make mistakes
- Misplace things
- Misread things; and
- Forget things!

- credit to Bob Sanstone, Power Gen and Construction Practice



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[www.glasbergen.com](http://www.glasbergen.com)



**“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”**



How do we get on the right track?

Develop a Strategy that gets:  
Management buy in  
Accountability  
Clear communication





Get the information you can!

## Market Assessment

What is the future operating profile?

What are the external factors?

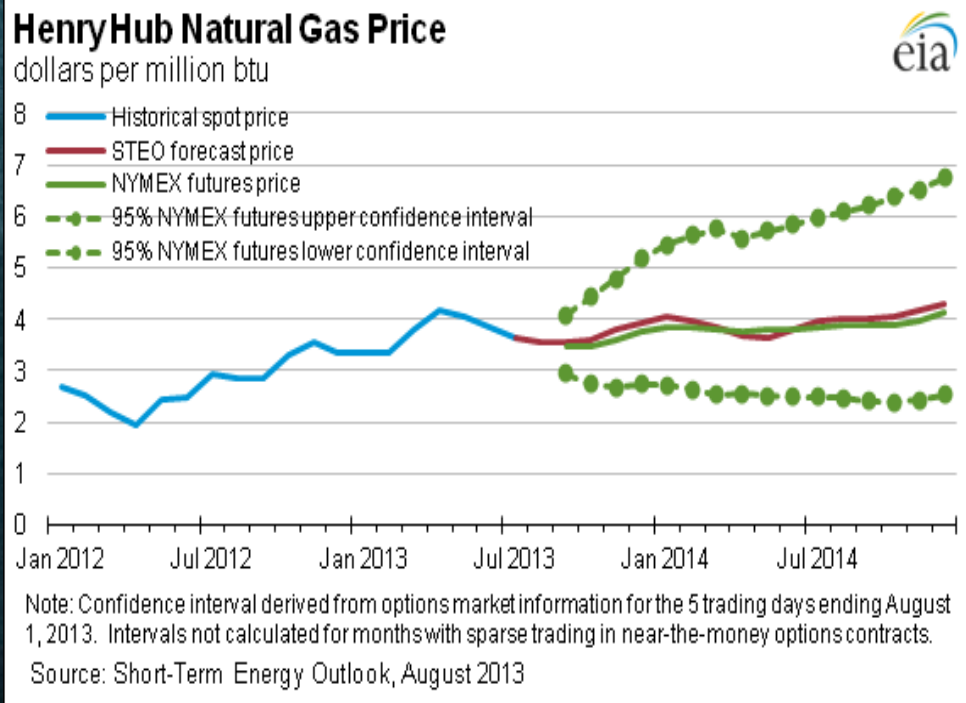
Multiple owners

Contract expiration

Supply and demand

Ancillary Services

Financing





## Maintenance Assessment

History of Failures (documentation, RCA)?

Have pressure parts been replaced?

Are there repeat issues?

Previous inspection findings:

Bowed SH and RH tubes

Inlet/Firing Duct Liner Failures

Gas Baffles Failures

Expansion Joint Failures

Corroding Drains

Fin Tube Fouling

Penetration Seal Failures





## Operations Assessment

What is the historical operating profile?

Hot/warm/cold starts/spin cooling

Are there nagging issues or 'work arounds'?

Does the chemistry need to be addressed?

Are the Operators well trained? Is refresher training a priority of the company?





After the assessment, list the issues

Sample Plant List:

1. FAC
2. HEP
3. IP Economizer Leaks
4. Liner failures in the inlet and firing duct
5. Catalyst life
6. Penetration seals
7. Drain corrosion
8. Outage Maintenance

Disclaimer - Any resemblance to plants real or imaged is purely coincidental

## FAC Risk Assessment –

Have we checked the critical areas?

What are the critical areas?

How can we get some confidence  
whether or not it is active at this plant?

To what extent?



## High Energy Piping

It is best practice to have a program.

Does the insurance company require a program?

Is there an insurance benefit to having a comprehensive program?

Is there 9% Chrome in the HRSG?

Are there large fatigue events (ie spray to saturation, lack of drainage in SH/RH)?





## IP Economizer Leaks – example of nagging problem

For this sample plant there have been IP Economizer leaks for which there is no root cause identified.

Leaks are at the tube to header joint and are generally sustainable until an outage for repair.

How do we determine root cause?

What collateral damage is occurring?



## Liner Failures

There are hot spots evidenced by peeling paint and casing cracks on the inlet duct.  
Is there danger or casing failure?  
How is this permanently repaired?





## Catalyst Life

SCR (and CO) Catalysts were specified for 3-5 year life and have been operating for 10 years. When can we expect replacement?

Is the 'in-kind' replacement available?

What are the effects of replacement?

Cost will be capital and in the \$500k range.

Have we taken samples?

Are the samples representative of our catalyst?





## Penetrations Seals

They don't last forever!

Leaking seals cause collateral damage to casing, wiring, and instrumentation as well as efficiency loss.

What is the best replacement choice?

How often will I have to replace in the future?



## Drain Corrosion

Leaks and condensation of flue gas cause water to be trapped continually in the cold end of the HRSG which leads to corrosion of drains and corrosion under insulation.

How thin are our drains?

How far does it extend in the piping?

What are the code requirements of this 'boiler proper' pipe?





## Outage Maintenance Plan

This is an item every plant should include to progress to preventative maintenance.

It includes all the 'usual' outage maintenance with a frequency and approximate cost.

Not capital projects

The output should be variable according to starts or operating hours and can be entered into an Enterprise system for tracking and work order generation.

Includes components of programs such as FAC and HEP inspections.



Elements to rank the issues:

Access – is the area accessible for maintenance or monitoring?

Lift/scaffold/crane required?

Insulation removal?

Outage required?

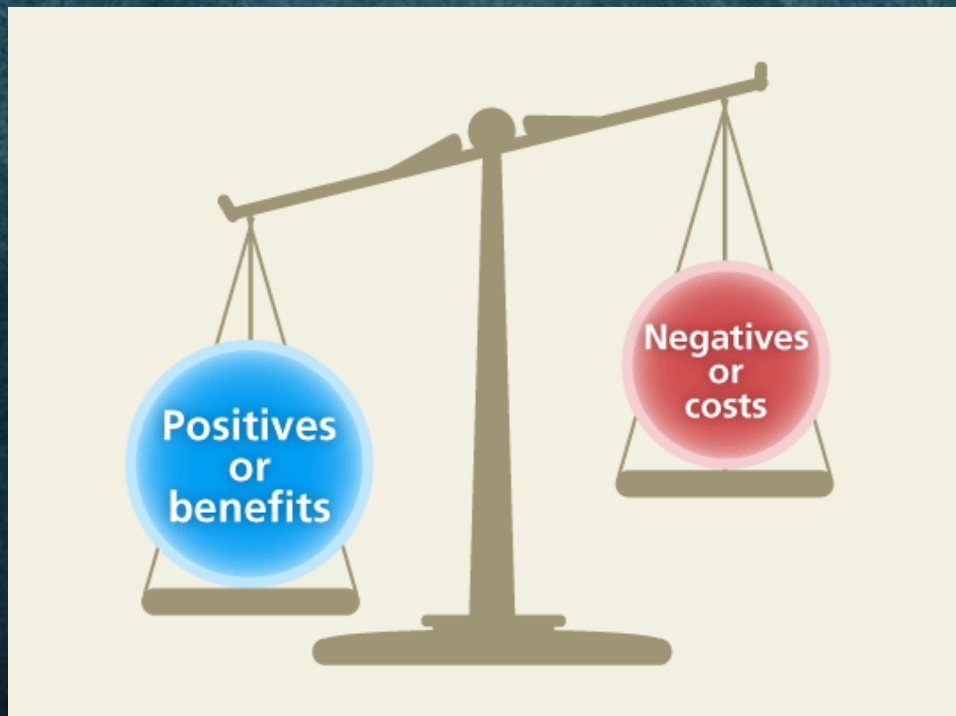




Cost Benefit – what is the budget cost to repair or replace? Does a cost benefit analysis need to be done?

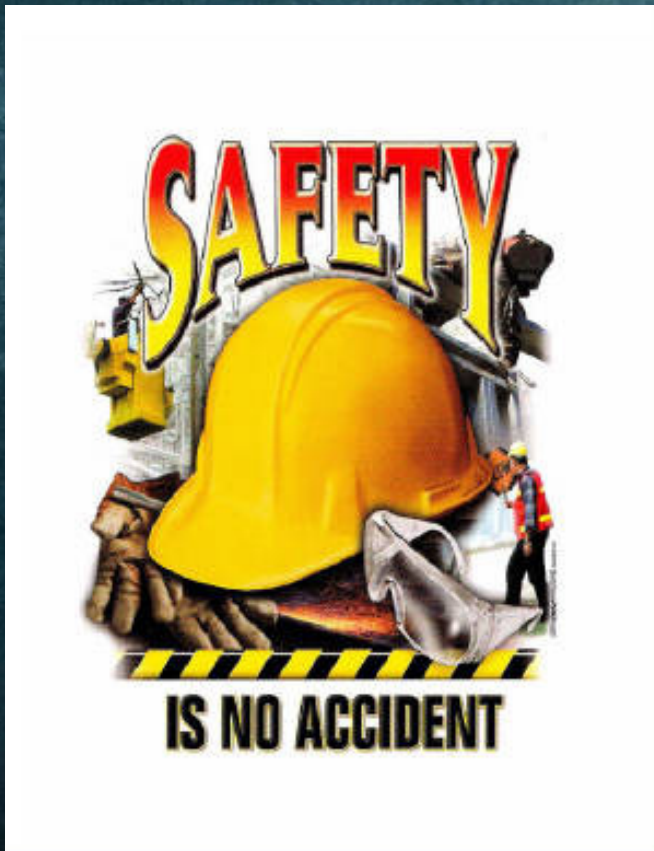
Capital vs. Expense

Firm Price/Budget/Guesstimate Basis





Safety – Is there a potential for energy release in an area inhabitable by personnel?



September 4, 2013

ALS Consulting LLC - Amy Sieben  
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CCUG Fall 2013 Meeting

Efficiency or Performance –  
Does the issue effect the  
efficiency or performance of the  
HRSG?







Issue	Description	Rank	Owner	Access	Cost	Safety	Reliability	Eff/ Perf
1	FAC Risk Assessment	High	Ms. Plant Engineer	No access issues for the risk assessment – Phase I	\$15,000 Firm Price Proposal	Yes	Yes	No
2	HEP Risk Assessment	High	Ms. Plant Engineer	No access issues for the risk assessment	\$50,000 Guestimate	Yes	Yes	No
3	IP Econ Leaks RCA	Med	Ms. Plant Engineer	No issue	\$10,000 Budget Proposal	No	Yes	Yes
4	Duct/Liner Failures	Low	Mr. Maintenance Manager	Scaffold	\$75,000 Budget Proposal	No	No	Yes
5	Catalyst Life	Low	Mr. Operations Manager	Crane needed	\$350,000 Firm Price	No	Yes	No
6	Penetration Seals	Low	Mr. Maintenance Manager	No issue	\$25,000 Guestimate	No	No	Yes
7	Drain Line Corrosion	Med	Mr. Maintenance Manager	No issue	\$10,000/Year Budget	Yes	Yes	No
8	Outage Maintenance	High	Mr. Planner	N/A	\$15,000 Budget	Yes	Yes	Yes



## The Goal?

Preventative Maintenance

Plan ahead

Budget properly

Minimize forced outage

Use personnel effectively

Use systems effectively





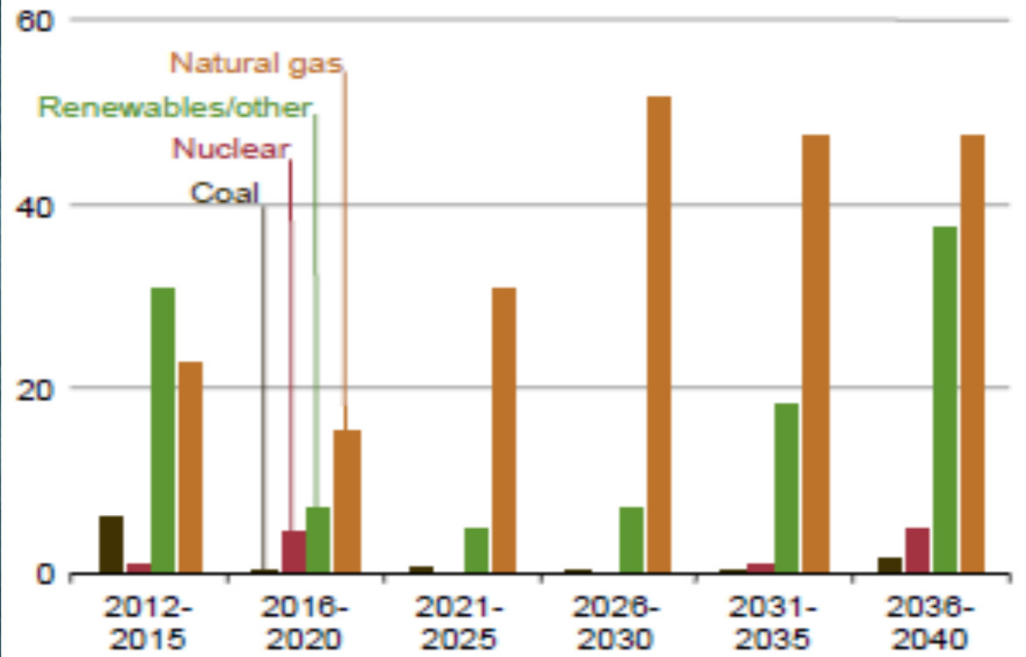
## The Benefits?

- Improved documentation
- Improved communication
- Improved planning
- Improved budgeting
- Increased safety
- Improved reliability
- Increased ownership
- Implementation of Best Practices
- Improved insurability





Figure 77. Electricity generation capacity additions by fuel type, including combined heat and power, 2012-2040 (gigawatts)



Source: EIA Annual Energy Outlook 2013

