NATURAL GAS SUMMIT 2014

LNG Development Strategy: The Master Plan

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Prepared by:

Sarah Fairhurst
sfairhurst@lantaugroup.com

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This Natural Gas Master Plan is intended to be different from previous plans…

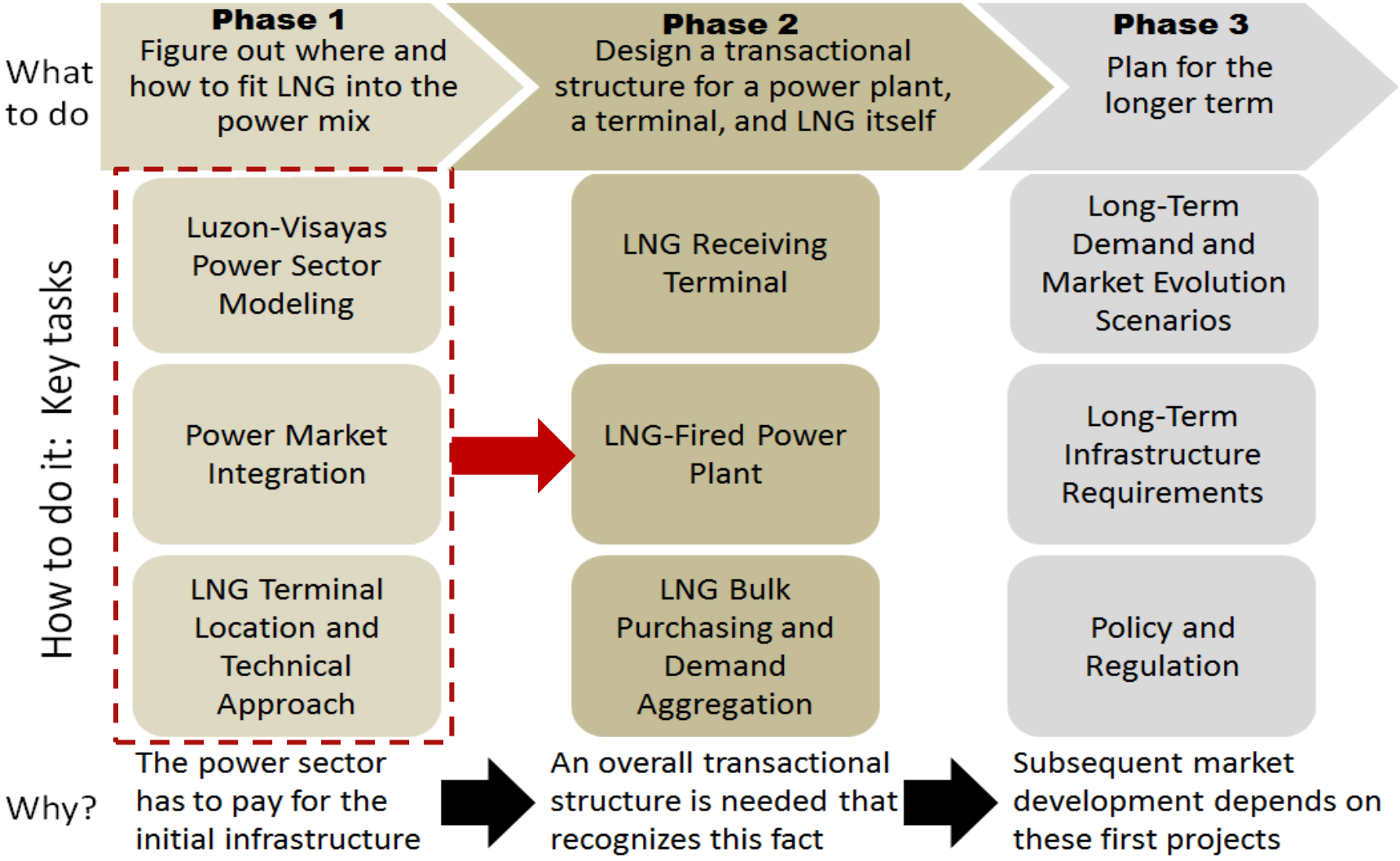
- The Philippines has had Master Plans for gas in the past
- **This plan is intended to be different**
- The main driver in the current Master Plan is to review the need for gas in the power sector and how to translate that into an LNG terminal which is the right size, at the right location, and at the right time to encourage economic entry of LNG into Philippines

… focussing on incremental delivery of flexible and economic infrastructure

- Instead of focussing on Government-driven infrastructure, this plan is intended to help Government facilitate the private sector to develop infrastructure
- We are also breaking apart the development process so that pieces of infrastructure can be separately delivered, rather than having a fixed and rigid plan where everything (or, as in the past, nothing) is built
- It is NOT about Government guarantees, Government construction of infrastructure or long term inflexible gas purchase contracts
- Nor is it about long term, high volume, inflexible contracts for LNG

Our key themes are economic entry, flexible supply resulting in least cost generation for consumers

Phases of work



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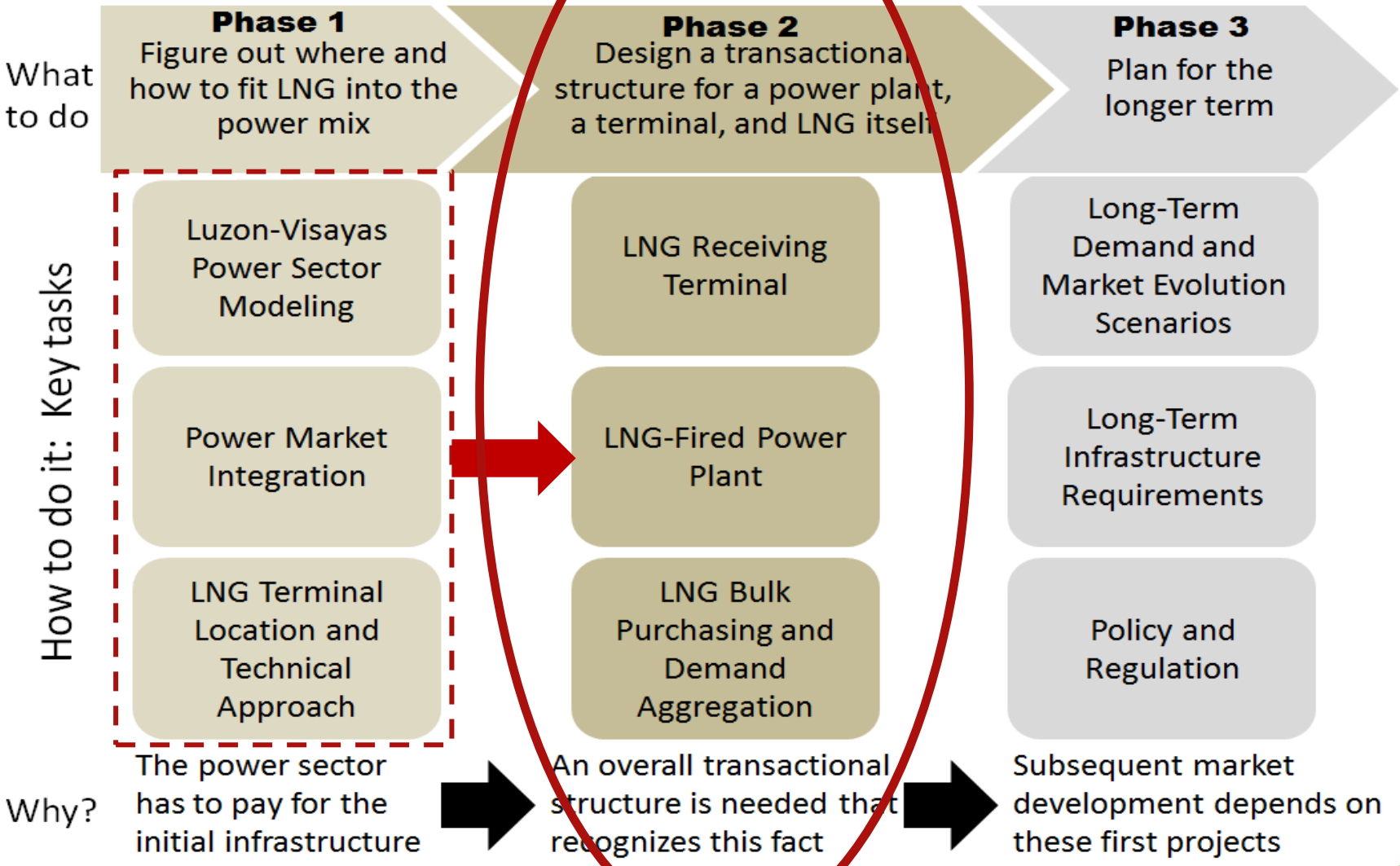
Phases of work

We are currently here



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Our first task was Modeling the Demand for LNG in the Power Sector

Objective:

- **To establish the fundamental economic case for LNG-to-power**
  - How many MW of LNG-fired capacity could be economically built?
  - How much LNG could this capacity consume?
  - What would affect the optimal timing?
  - How might additional supplies from Malampaya be most economically used? And how does this affect the demand for LNG?

Source: [1] *Mindanao Power System Modelling*, Stephen Wallace (January 2013)

You may well have already seen some press coverage of our first Report

MANILA BULLETIN
THE NATION'S LEADING NEWSPAPER

Manila Bulletin – Fri, Dec 27, 2013

It was shown in the simulations that if the base fuel cost for coal will be at US$4.18 per million British thermal unit (BTU) equivalent for year 2014, the corresponding LNG cost will be at $15.97/mmbtu. This is also higher than the Malampaya-sourced fuel for Ilijan gas plant at $10.62/mmbtu and even with bunker fuel at $15.75. By 2015, if coal will be at $4.25, LNG cost will be at $15.23/mmbtu, while Ilijan gas will be at $10.28. Of the comparative fuels presented, it has been "distillate" that will come more expensive than LNG.

- Unfortunately, this coverage completely missed the point about how gas, even at prices much higher than coal, could be economic.
- As it can. Provided it is used correctly

Many people in the electricity industry in the Philippines struggle with decisions about which type of plant to build, or which power to purchase

The key issue is making decisions about the fixed vs variable costs of the problem…. However….

There are plenty of everyday decisions we make about fixed vs. variable costs!

- Filament lightbulb vs. CFL vs. LED
- Monthly travel pass vs. Single ticket *[on systems other than MRT/LRT]*
- Mobile telephone contract vs. prepaid
- Car rental vs. car purchase
- Hotel vs. property lease vs. purchase

Filament ***CFL*** ***LED***

Fixed cost: **Low** → **High**

Variable cost: **High** → **Low**

[This is indicative since the claimed lifetimes also vary]

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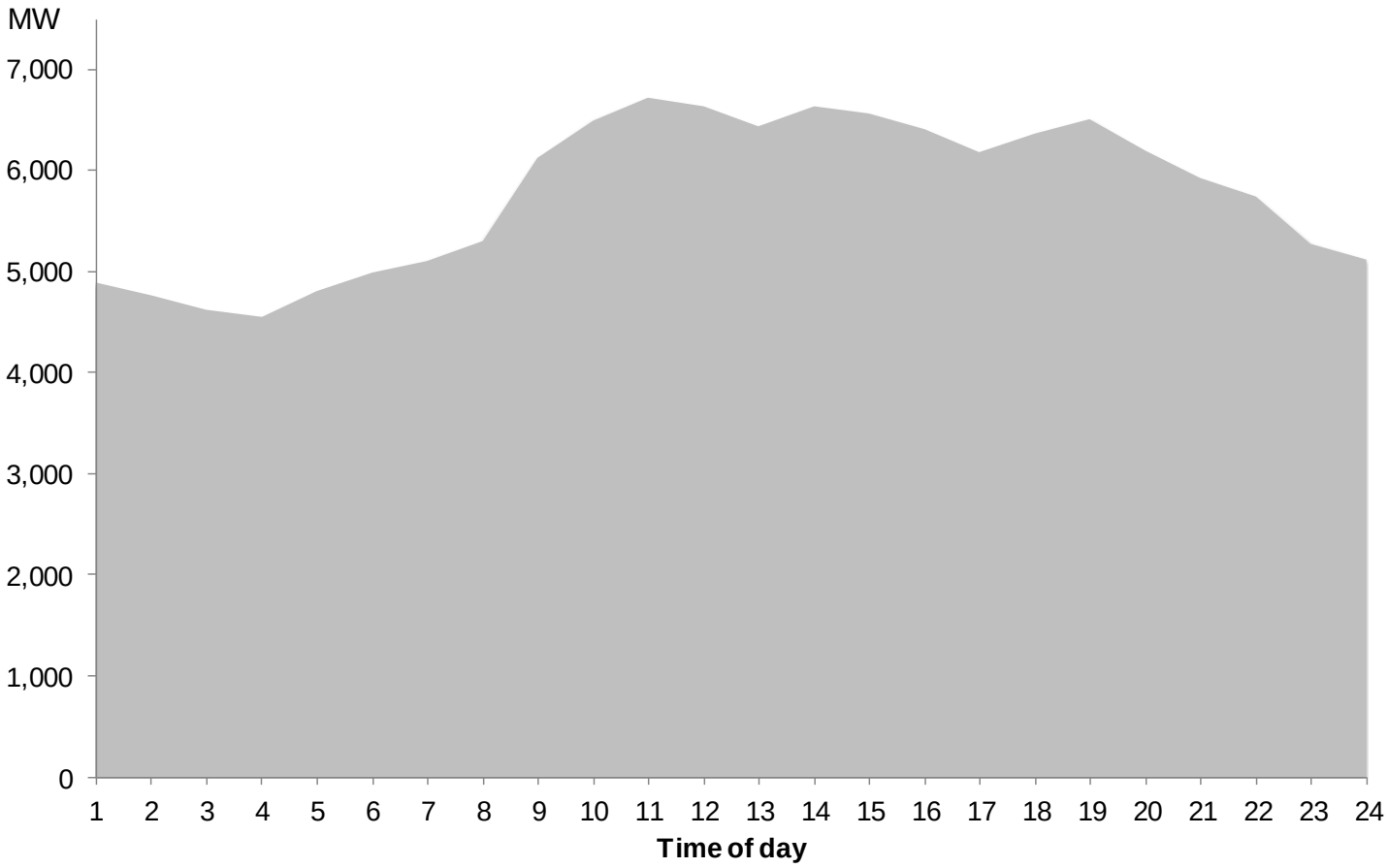
In order to understand where gas fits, you need to look at how electricity supply and demand fit together

Electricity demand in Luzon on an illustrative day (Friday, 10th January 2014)



Key points to note are that demand is:

- low overnight (when people are sleeping and businesses are shut)
- high during office-hours
- another peak when people get home from work in the evening

Source: PEMC

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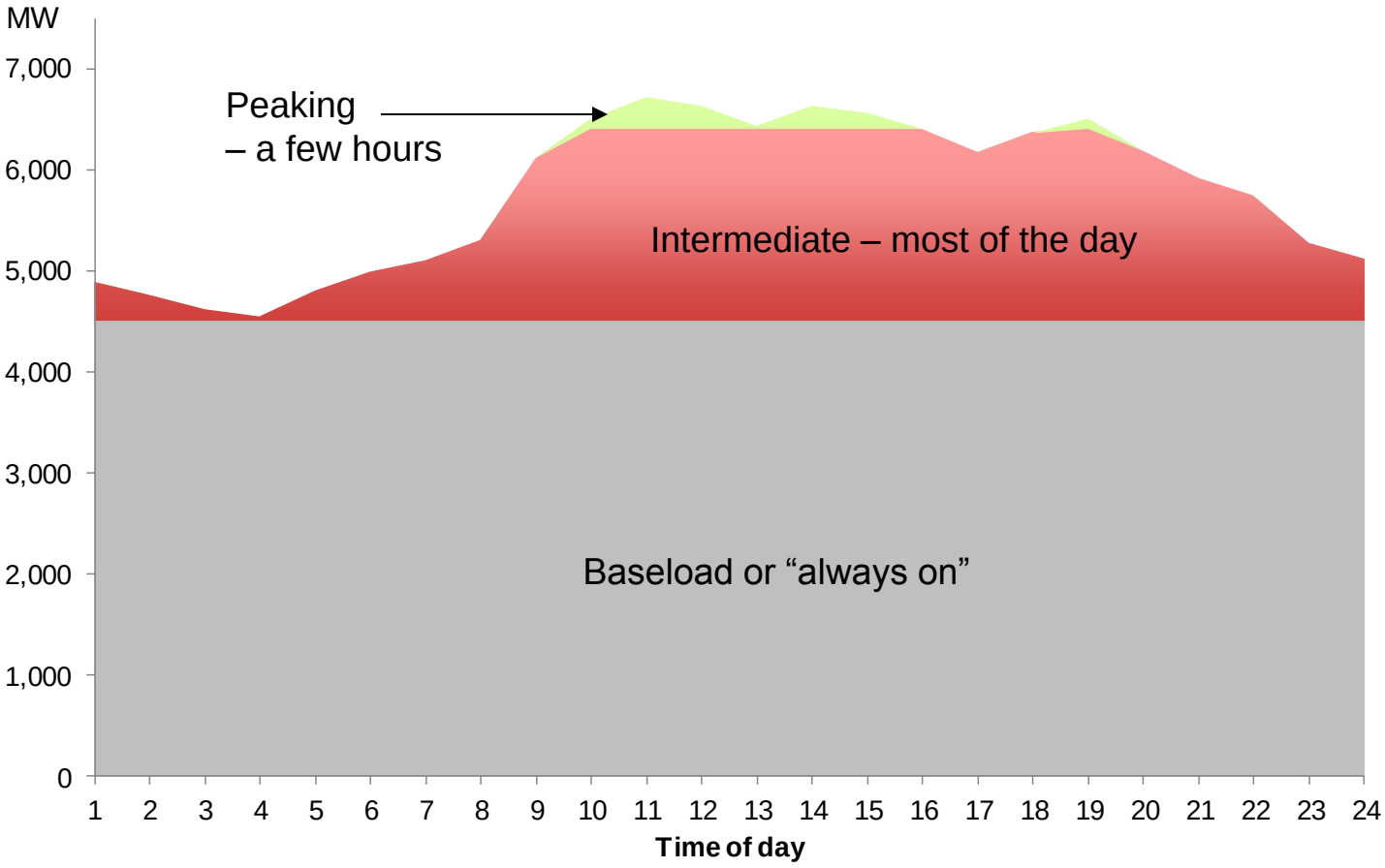
Demand for electricity varies by time of day, and electricity (mostly) cannot be stored so supply needs to match demand in every minute

Electricity demand in Luzon on an illustrative day (Friday, 10th January 2014)



We can divide the demand up into three kinds of demand:

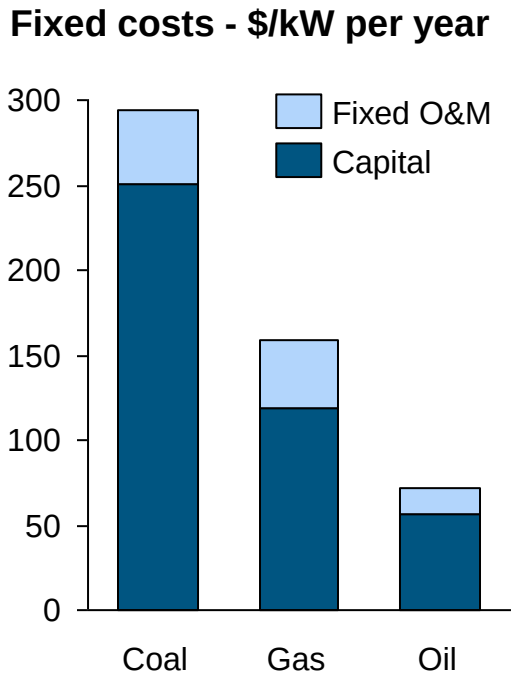
- **Baseload**: Which is always needed
- **Intermediate**: which is mostly needed during the day
- **Peaking**: Just a small amount needed in a few hours

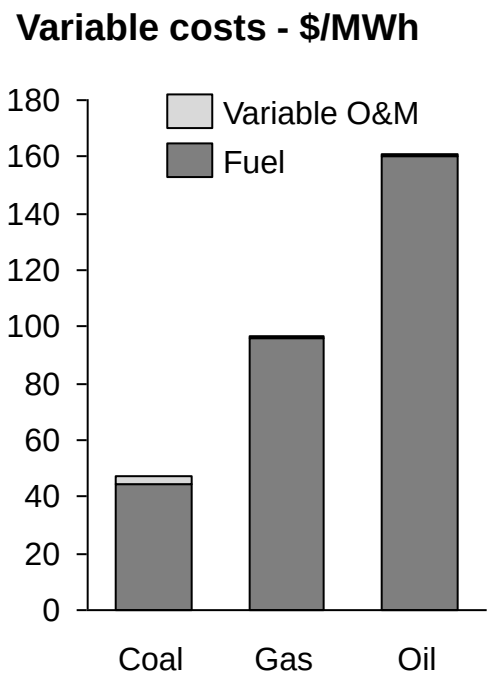
Source: PEMC

On the supply-side, different kinds of power stations have different cost structures

Different kinds of power stations have different cost structures:

- Coal plants are very expensive to build but relatively cheap to run
- Gas plants are relatively cheap to build (even taking into account an LNG terminal needed too) but quite expensive to run
- Diesel plants are extremely cheap to build but very expensive to run





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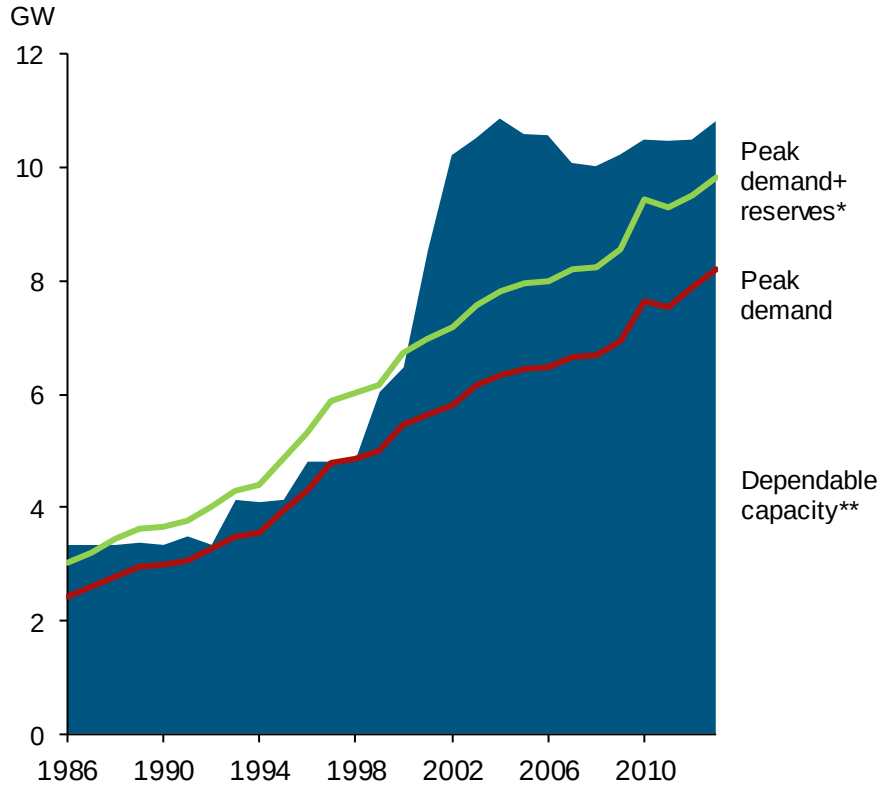
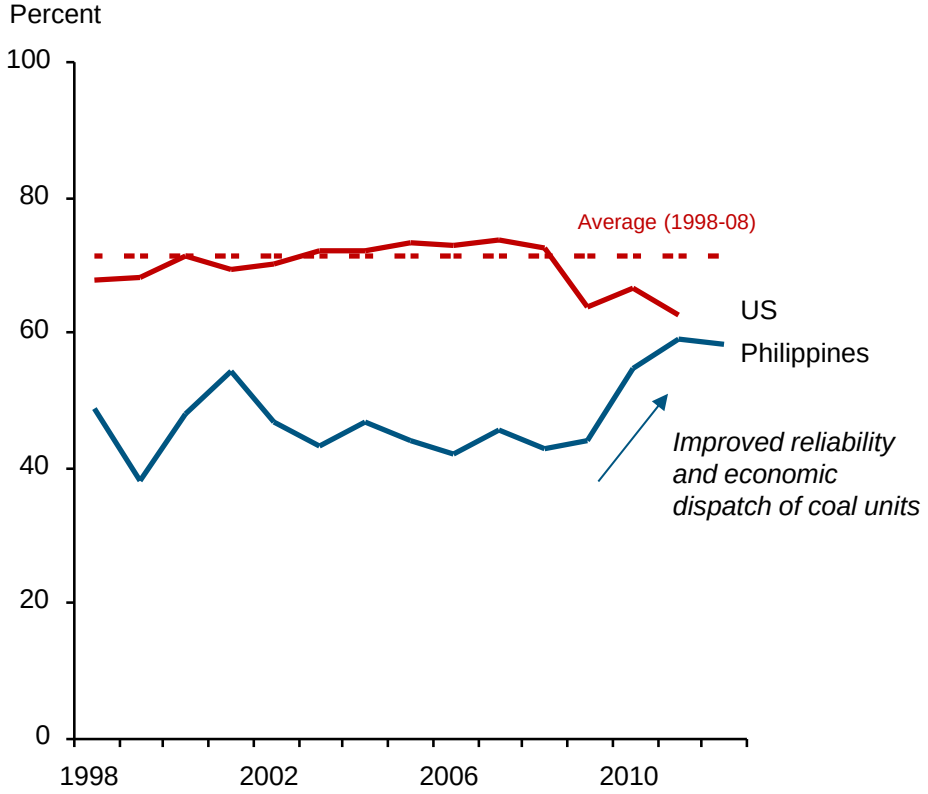
New power stations are needed soon…

Supply and demand in Luzon (1986-2013)



Annual capacity factor of coal-fired power plants (1998-2012)

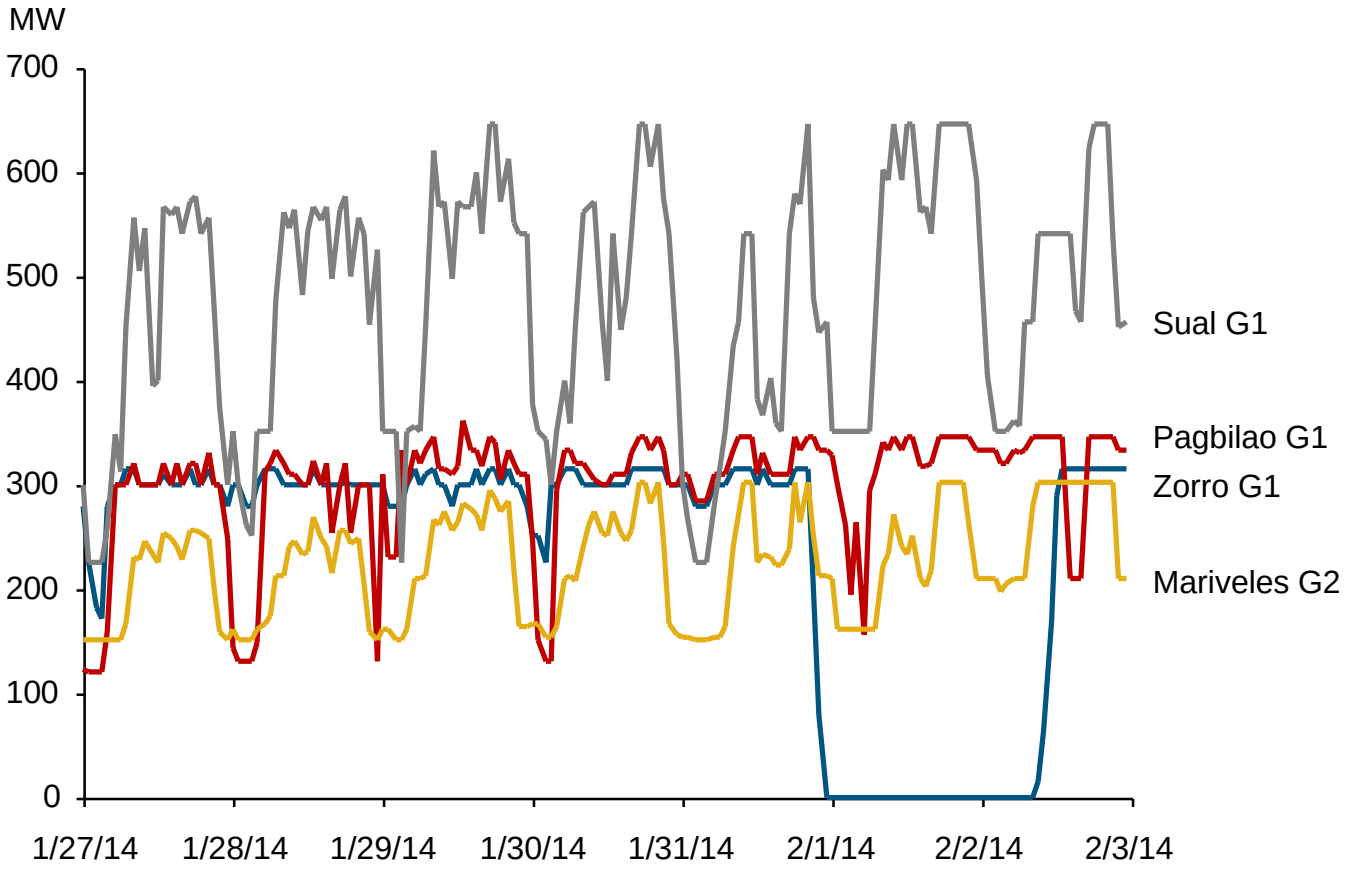


Note: * Philippine Grid Code previously mandated 23.4% reserve be available, since 2011 it has required 4% for frequency regulation, a quantity equal to the most loaded unit for contingency and a quantity equal to the second most loaded unit for dispatchable; ** Dependable capacity is the maximum capacity factoring plant reliability and ambient limitations.
Source: DOE; US EIA

… and some of the new capacity needs to be flexible

The existing situation requires that some coal plants, such as Pagbilao, Sual & Mariveles, are ramped up and down to meet demand causing thermal stress on the plants

Typical weekly generation schedule (w/c January 27, 2014)



Source: PEMC (ex-post schedules)

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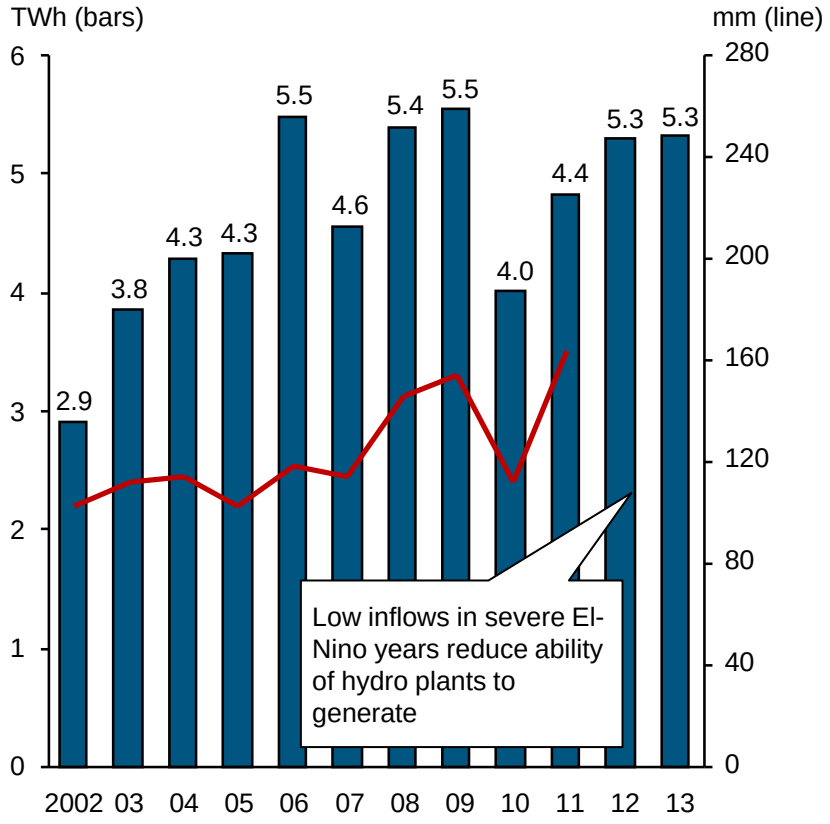
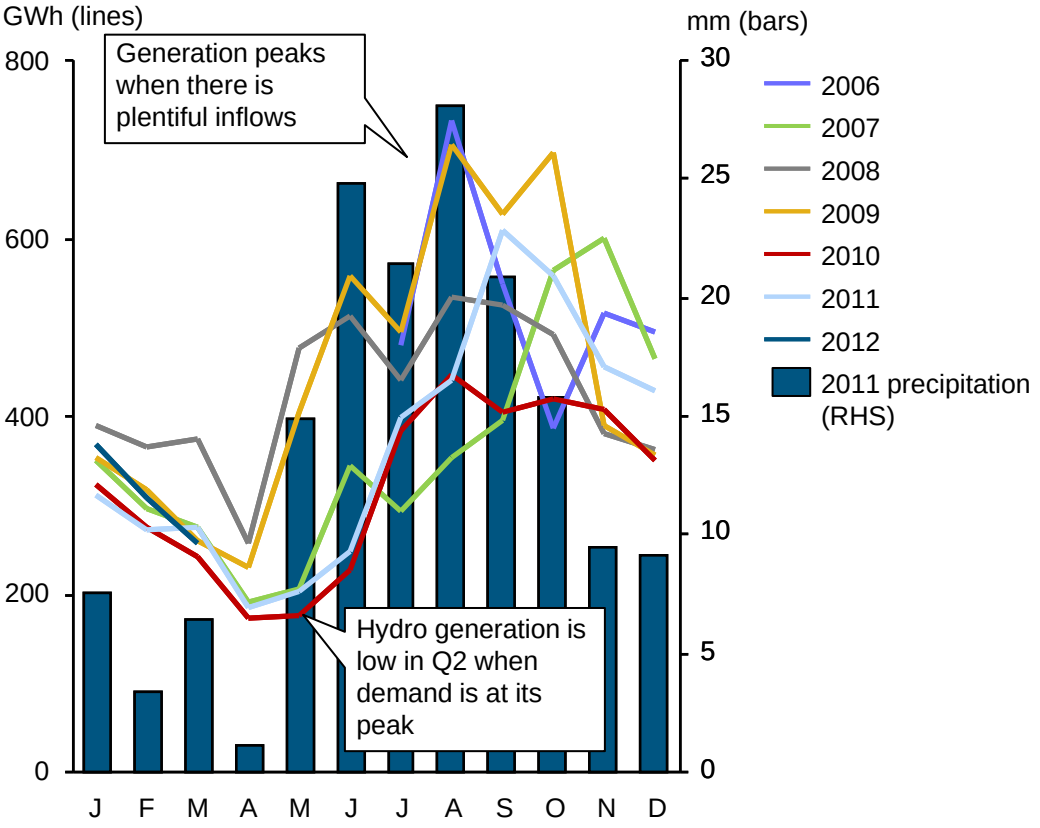
Hydro inflow also vary meaning different amounts of thermal generation are needed each year

Annual hydro generation in Luzon and rainfall (2002-13)



Monthly hydro generation in Luzon and 2011 precipitation (2006-2012)



Source: DOE Power Statistics (2002-12); PEMC (2013); TLG analysis; NOAA

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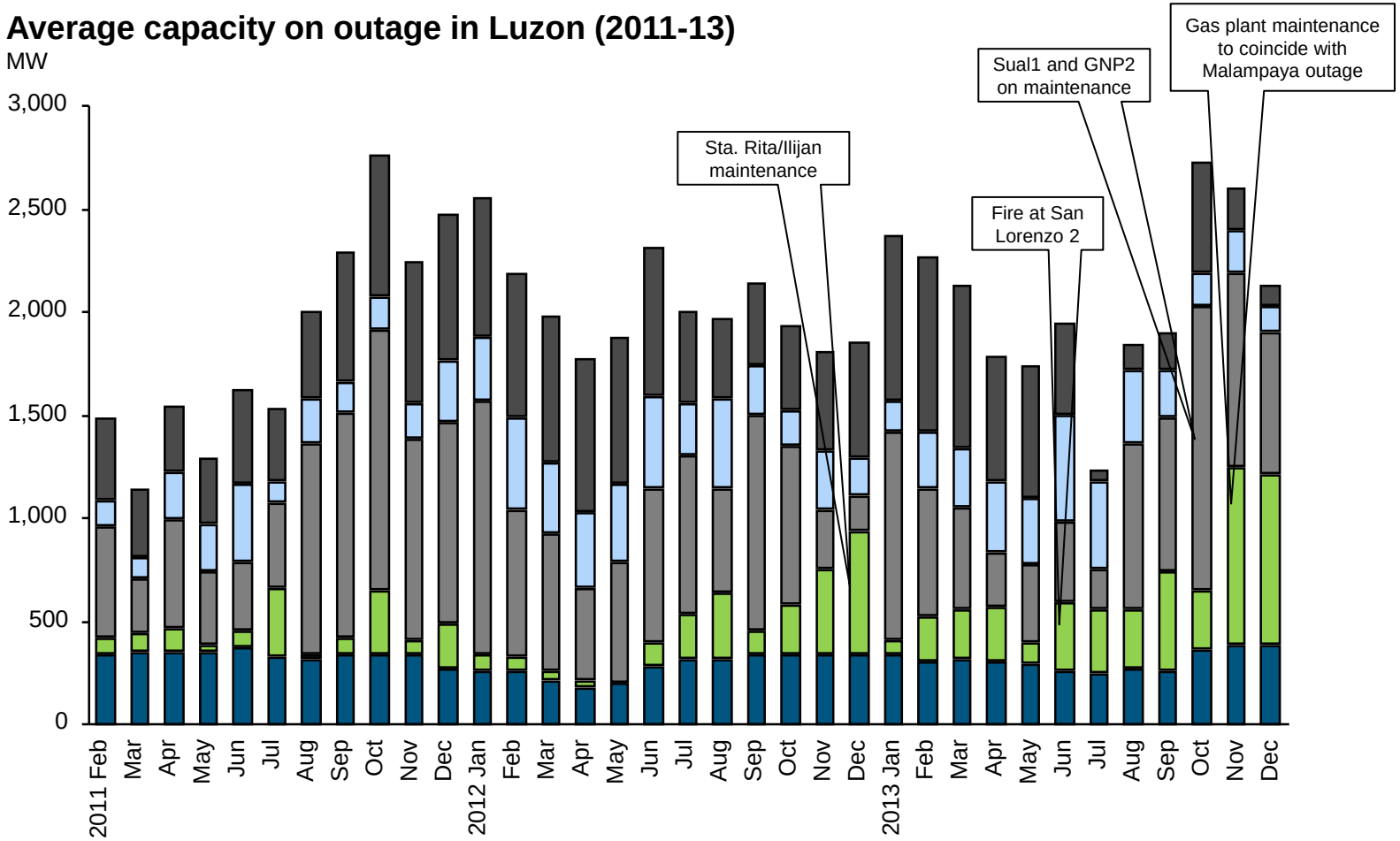
And outage levels are generally high in the Philippines so extra spare capacity is needed



Source: PEMC; TLG analysis

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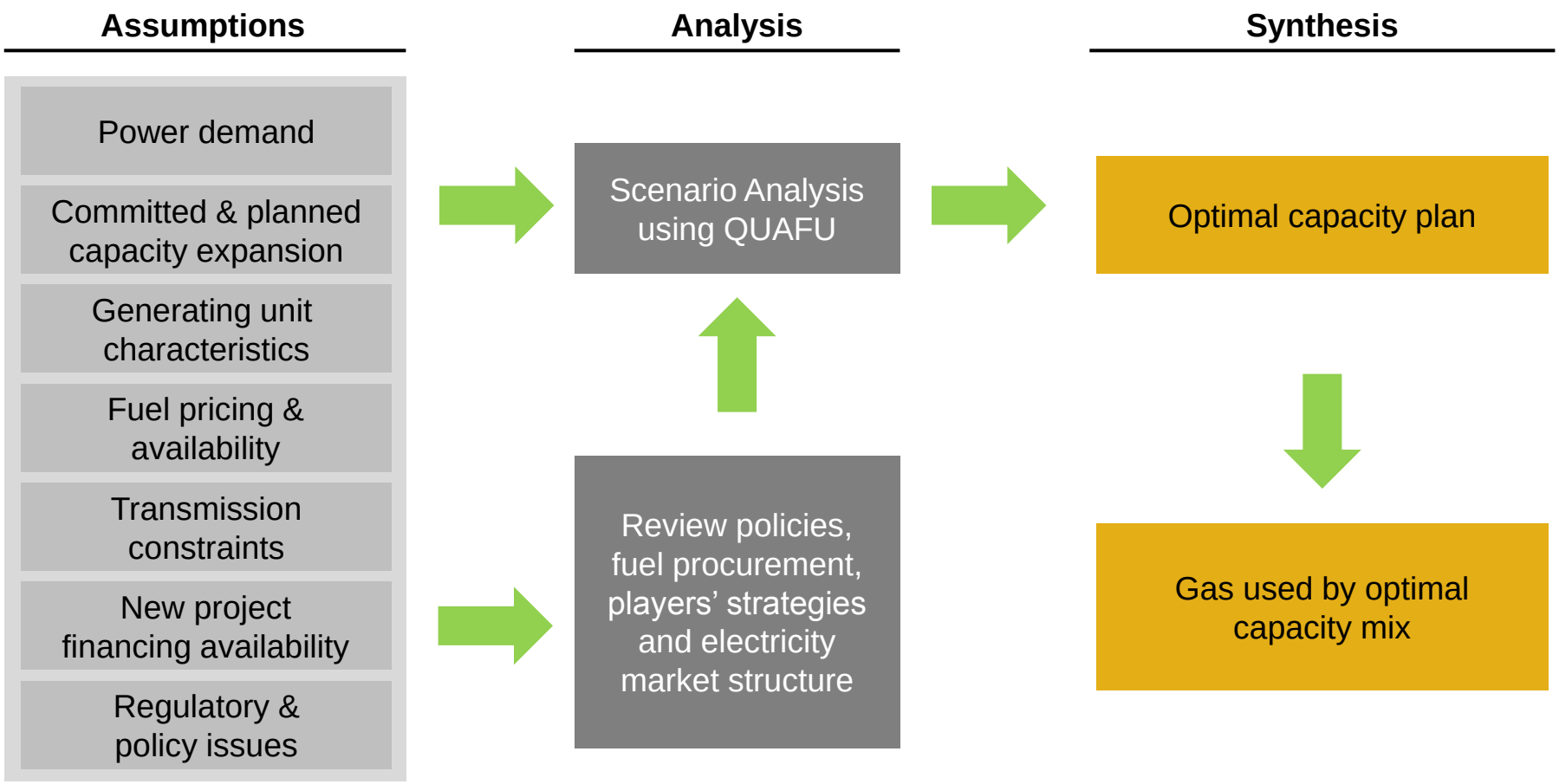
Our modelling needed to take all this into account and determine the optimal level of new gas fired capacity needed and also how much gas it would burn



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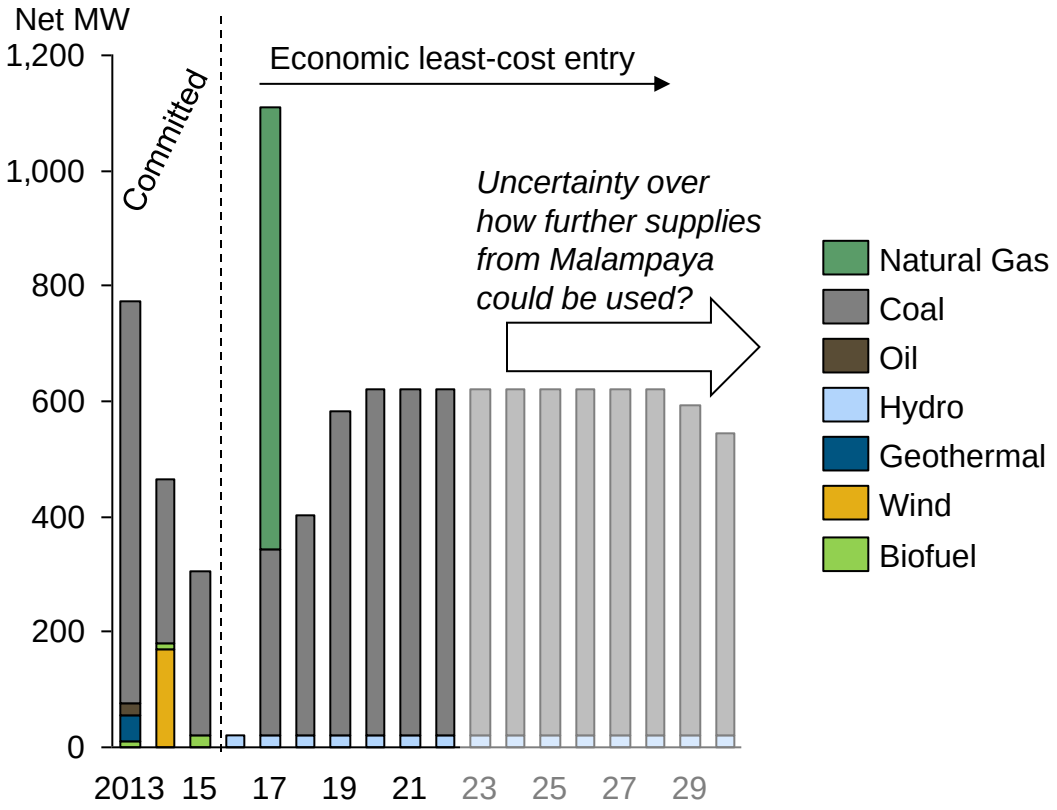
The least cost capacity expansion included some gas capacity in the near term for mid-merit duty

Least-cost capacity expansion plan for Luzon under expected assumptions



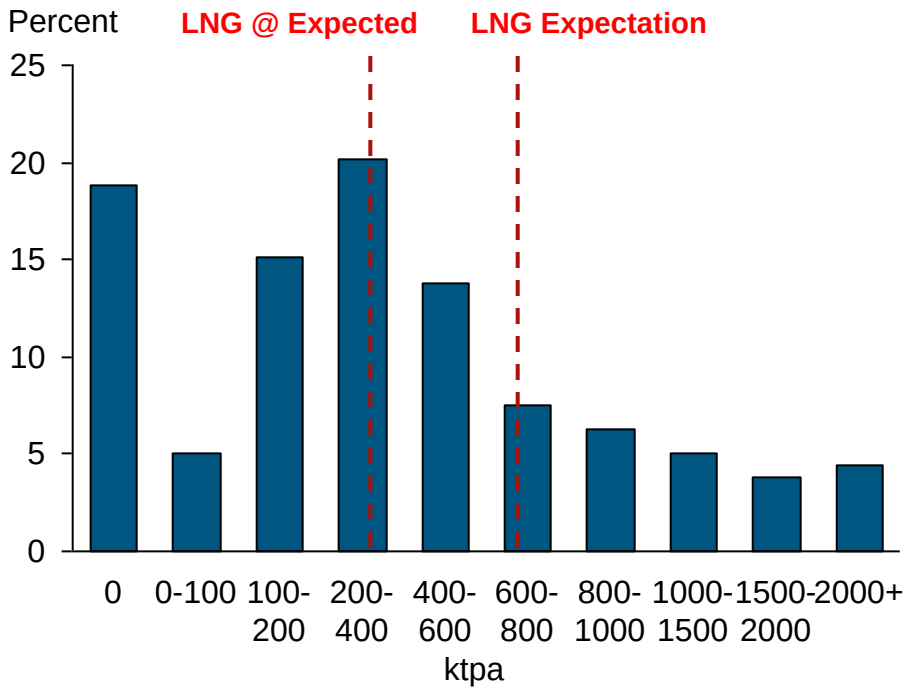
- Near-term need for more cost effective mid-merit / peaking capacity
- Conservatively, an LNG-fired CCGT of about 600-800 MW and a LNG import terminal appear to be the least-cost option
- They are able to recover reasonable returns on their invested capital (including for terminal)
- The amount of LNG-fired capacity required is relatively robust to near-term committed capacity
- However, at expected coal and LNG prices, coal generation will continue to be least-cost option for most of future capacity requirement

Note: EWC plant assumed to not be committed
Source: DOE (committed plants as of Aug 2013); TLG analysis

The modelling also highlighted a high variability in how much gas might be burnt each year

Major sources of market uncertainty	Value in options that are flexible
Relative fuel prices	Less capital intensive
Annual load growth	Without binding fuel supply constraints
Hydro resources	Faster to build
Capital costs for new plants	Faster to ramp dispatch

Probability distribution of economic quantities of LNG in 2020



This highlights that the solution needs to include flexible purchasing and not long term take or pay contracts

Source: TLG analysis

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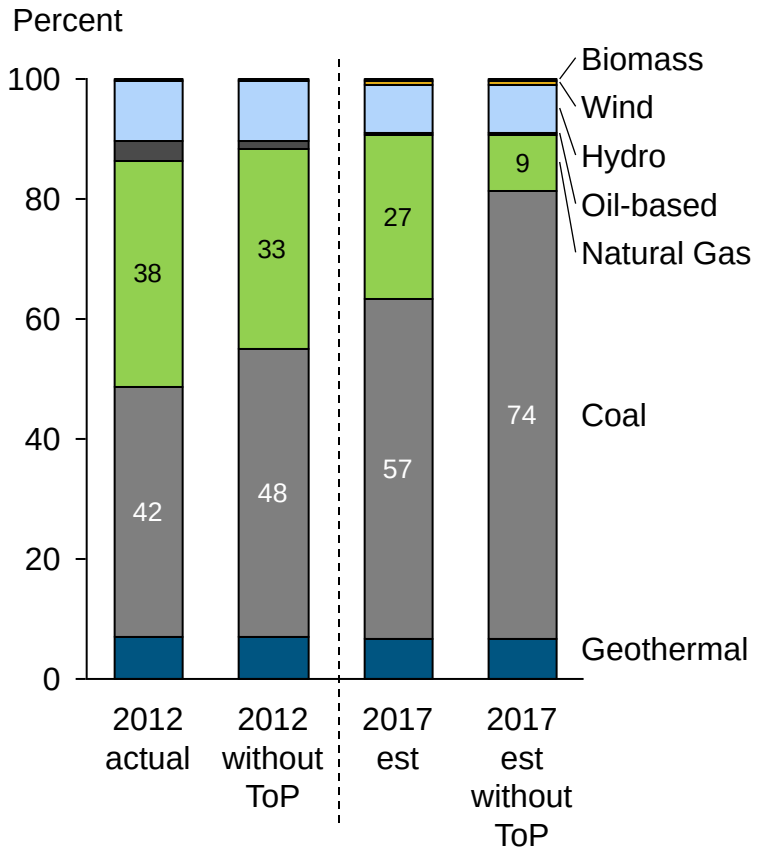
More flexible usage of Malampaya could also lower system costs

- The existing Take-or-Pay (ToP) arrangements in the GSPAs imply very high (baseload) capacity factors
- Without these ToP constraints, economically the gas-fired plants would run less
- Additional uncontracted supplies from Malampaya could be offered to buyers under terms and prices different to the current GSPAs
- If the Malampaya gas were priced up to close to LNG prices, then in the long-run the existing 2,700MW could act as mid-merit / peaking capacity
  - economically about 0.03 tcf p.a. would be consumed (if LNG were also present) – a level that would exhaust the additional recoverable reserves within about 11 to 18 years

Luzon generation fuel mix



The Master Plan is therefore also looking at how post-2024 options for Malampaya fit into the mix

We also identified that the ability to back-up Malampaya supplies appears to be valuable option worth about $20m-$25m p.a.

- Pursuant to the approved PPAs, the cost of liquids* used as replacement in Sta. Rita/San Lorenzo can be passed onto consumers
- Reduced availability also means more expensive generation is needed to replace lost capacity
- Imported LNG should be more cost effective than liquids, meaning that having the option to back-up Malampaya with LNG is a valuable option

	Start date	Duration	Estimated additional system cost (mPhP)
Scheduled Malampaya maintenance outage	22 Nov 2006	25 days	2,500
	27 Jun 2008	4 days	1,000
	10 Feb 2010	30 days	1,300
	20 Oct 2011	7 days	900
	13 Jul 2012	8 days	600
	11 Nov 2013	30 days	4,000
		Subtotal:	10,300
Unscheduled Malampaya supply outages	Average curtailment of 1,700MW over about 287 hours since 2006		740
		Total:	**11,040**

We are therefore looking a contractual solutions that capture this value

Note: * Used in scheduled maintenance outages
Source: DOE; TLG analysis

Conclusions of Phase 1 modelling

- There is a reasonably robust economic case for a modest (about 600 - 800MW) of LNG-fired CCGT that can economically dispatch at mid-merit capacity factors but still underpin investment
- In particular, the option to replace the Malampaya gas during outages appears to be worth about $20m-$25m p.a. to the system, which is an order of magnitude greater than the cost differences on a present value basis
- The fundamental uncertainty over key drivers of LNG demand creates flexibility value
- If the LNG infrastructure investment is going to realise that option value, the import terminal and the supply chain needs to be flexible and able to cope with relatively large swings in demand

Key take-aways from Phase 1

Policy direction

- Private sector, market-based solution is critical
- Everyone must have access to the benefits of LNG
- Burden on regulated power customers must be minimised
- Clear case for Government action to solve market failures in providing Malampaya backup
- Improvements in clarity and efficiency of regulations and rules covering gas and gas-to-power are needed

Implementation recommendations

- Delink LNG terminal from specific new power plant capacities
  - LNG terminal services for regulated power customers
  - LNG terminal services for others
- Competitive selection process to:
  - market test the opportunity through an open season for capacity
  - parallel process to find least-cost infrastructure supplier

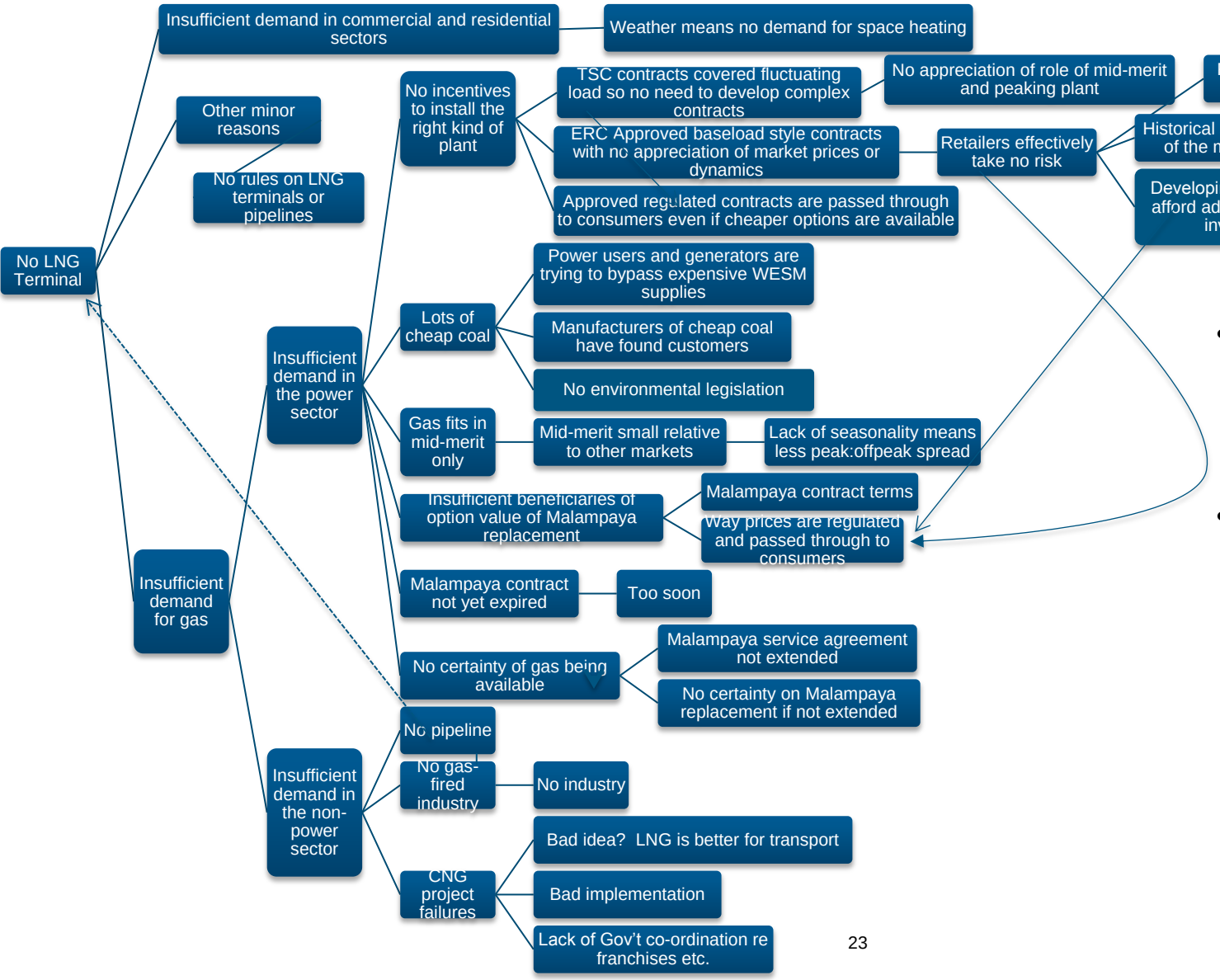
The next step was to identify options for the DOE to review

- The first question we addressed was “why is this not happening on its own?” because if there is an economic case for gas and no gas enters, this highlights the existence of market failures

> *Market failures occur when the benefits of an activity are diffuse and unable to be captured by commercial parties such that although an activity is economically sensible, it’s commercially unviable.*

- However, market modelling suggested that there had been no economic case prior to now – meaning that any market failures are impossible to see to date and have to be estimated

Drivers of "No LNG Terminal" are multiple, complex and often interrelated



- It is NOT clear-cut that market failures are preventing new LNG infrastructure
- Fact that EWC is already under construction and several other credible parties are exploring options highlights the fact that even if market failures exist, they have not actually prevented investment yet

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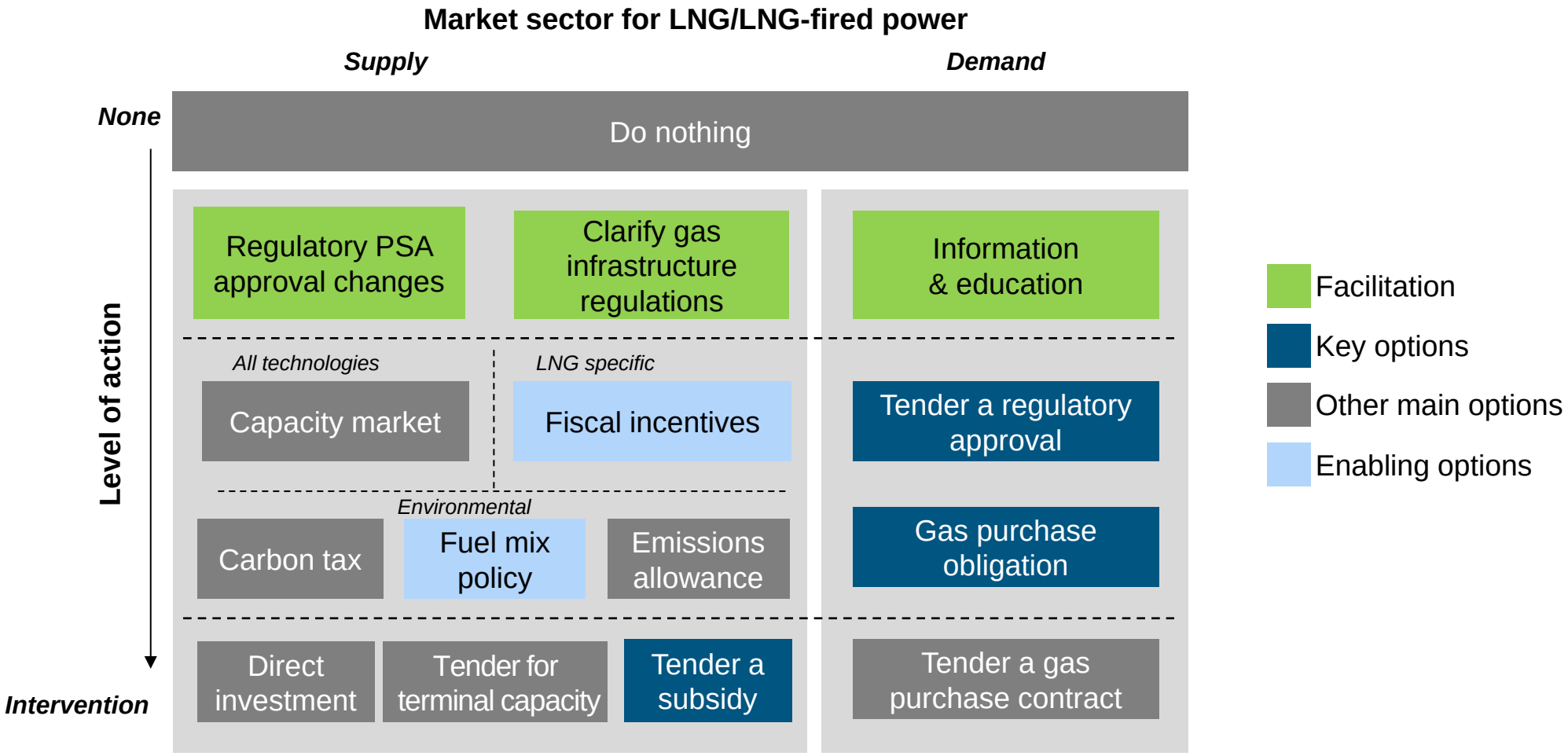
We identified the following possible market failures

- Environmental impacts not internalised in the market
  - Coal can cause higher emissions of SOx, NOx, particulates and CO2 than gas but there is currently no mechanism in the Philippines to take into account these impacts on the local and global environment
- Maturity of market
  - With RCOA only recently adopted and no financial derivative contracts available, contract purchasing strategies are not yet mature in the market. LNG-fired power is a complex option making it much harder to evaluate against simple purchasing strategies
- Regulation of contracts
  - To date, contract regulation has been mainly on a “cost plus” basis that does not market prices. As such it makes it harder to highlight how mid-merit and peaking generation options fit into the mix compared to “cheaper” baseload coal
- Diffuse benefits of gas options unable to be captured commercially
  - There are many benefits of gas, but it is hard to ensure all the beneficiaries pay their share of the costs
- Clarity of rules on NG and NG infrastructure
  - Improving clarity on rules for access will given players more certainty on the commercial deal they are entering into

Using the market failures, we proposed a number of options for the DOE to consider



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One favourite option was to focus solely on facilitation that removes barriers

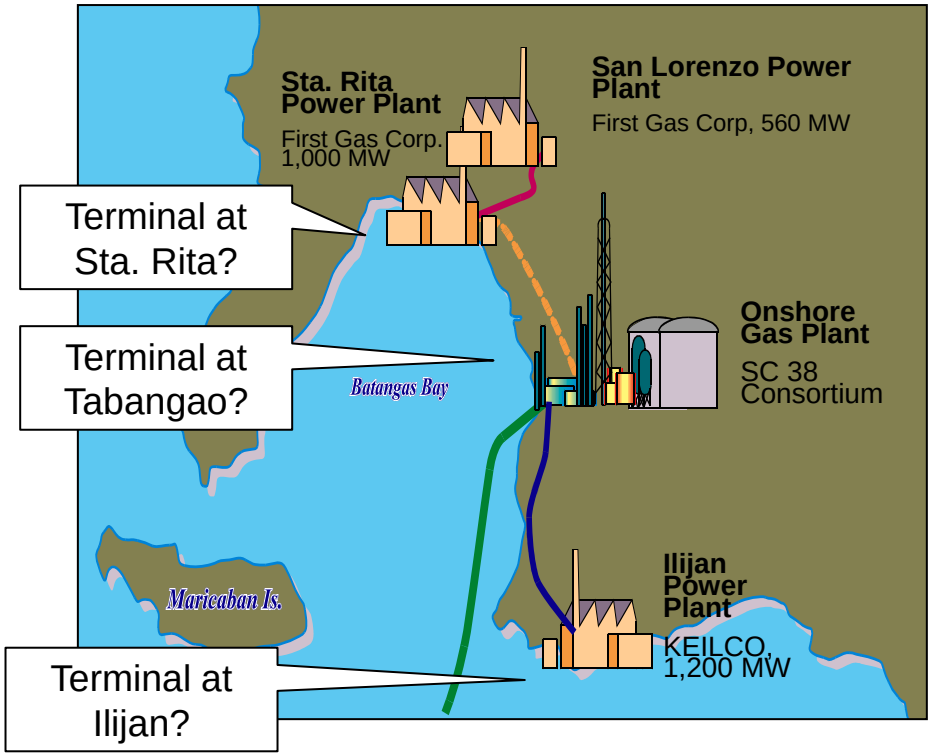
- A number of key barriers include:
  - Shortcomings of the current regulatory framework that have no incentives for retailers to purchase in a least cost manner taking into account their demand profile
  - Issues in the design and operation of the WESM
  - Lack of gas-related policy and legislative frameworks
  - Inexperience and lack of expertise in the private sector (particularly the smaller PIOUs and ECs)
- One option was to focus just on addressing these issues since gas fired power stations and terminals are already close to being commercial and it may only take minor tweaks and improvements to facilitate entry
- Fixing obvious problems has wider benefits than just gas or LNG – it also makes other investment in power easier and faster while education and capacity building contribute to better decision making and more economic outcomes generally

However, facilitation alone was not considered sufficient

- An “active” option was considered necessary in addition to facilitation
- A gas purchase obligation (similar to the proposed renewable portfolio standards being implemented for renewables in the Philippines) was a strong contender
- But on balance, it was felt that the right option should be simpler and focus on:
  - Separating infrastructure from gas purchase, to fast track the infrastructure and allow options for gas purchasing
  - Monetise the terminal on the basis of savings to franchise consumers – the simplest of which to realise is based on making backup to the existing gas supply cheaper
  - Open the door for the various private sector entities to contract for terminal capacity on an open and transparent basis

Near-term vision: LNG terminal in Batangas to back-up Malampaya with balance of capacity for market

Possible sites for LNG terminal connecting directly to Malampaya



Our technical advisors (Arup) are currently studying the technical feasibility of an FSRU offshore from the Ilijan site

- Recognise case for Government action to solve market failures in providing Malampaya backup
- Structure transaction around terminal
- Implement in phases
  - Test strength of market demand with open season
  - If lost, revisit options for integrating LNG import with power sector
- Benefits are largely neutral to outcome of EWC in Pagbilao
- Potentially replicable in Mindanao
  - Terminal capacity in Mindanao could be used to break-bulk to Mindanao
  - Terminal technical specifications would have to include option for small ship loading

The Government would need to enable the private sector

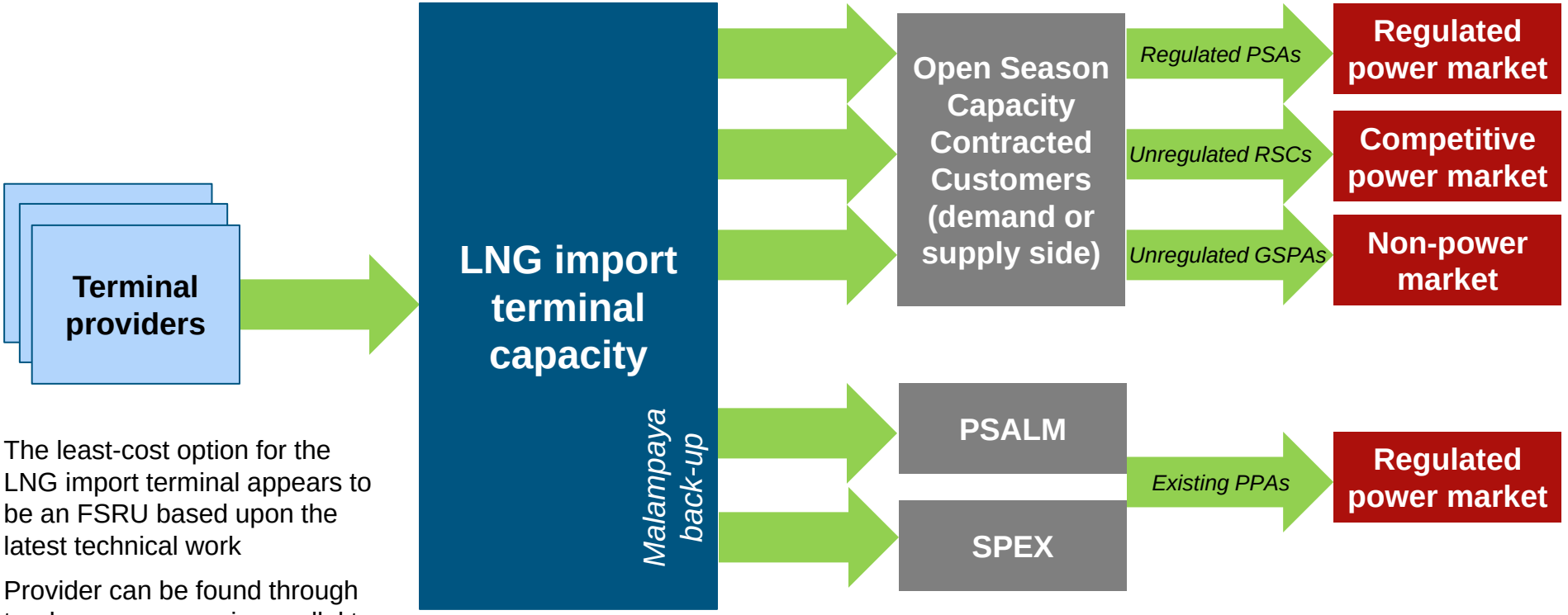
Facilitate general market development

- Facilitation strategy: education and capacity building
- Clear policy / guidance to ERC on how to review proposals for mid-merit LNG-to-power for captive customers

Enable development of terminal infrastructure

- Issue policies for some terminal capacity to act as backup to Malampaya
  - Ensure PSALM seeks least-cost replacement supplies for Ilijan through LNG imports rather than distillate fuels
  - Ensure captive Meralco customers are not required to pay the premium of distillate fuels over LNG imports for Saints under the regulated PPAs
- Government entity to facilitate open season on remaining terminal capacity
- Terminal secures revenue certainty (and is therefore financeable) from:
  - Captive power customers through supplies to First Gen/PSALM for Malampaya back-up
  - Contracted capacity for open season respondents in:
    1. Regulated power market
    2. Competitive power market
    3. Non-power market

Our indicative recommendation on the terminal infrastructure is as follows



- The least-cost option for the LNG import terminal appears to be an FSRU based upon the latest technical work
- Provider can be found through tender process run in parallel to open season for capacity
- No Government support or guarantees for terminal capacity
- Contracts are entirely private-sector to private-sector (apart from PSALM)

Our initial recommendations on gas purchasing are still under review

- Sellers of gas would be able to purchase terminal capacity in the open season
- Buyers of gas may aggregate to tender for known gas supplies
  - The tender mechanism should prevent less experienced buyers being disadvantaged in the LNG market
  - Should make it easier to demonstrate least cost purchasing for regulatory approvals
- Gas purchases may be on a mix of long, medium and short term basis
- Any purchases should allow diversion of cargoes to avoid being locked into high take-or-pay levels

There is still more to do

- Phase 2 report was delivered 3rd March
- Public consultation is on 20th March
- Next steps include:
  - Undertaking Phase 3 which involves looking at scenarios of future developments

The Lantau Group
4602-4606 Tower 1, Metroplaza
223 Hing Fong Road
Kwai Fong, Hong Kong

Sarah Fairhurst
sfairhurst@lantaugroup.com

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strategy & economic consulting