Focusing on the people: Big Grid or Distributed Electricity?

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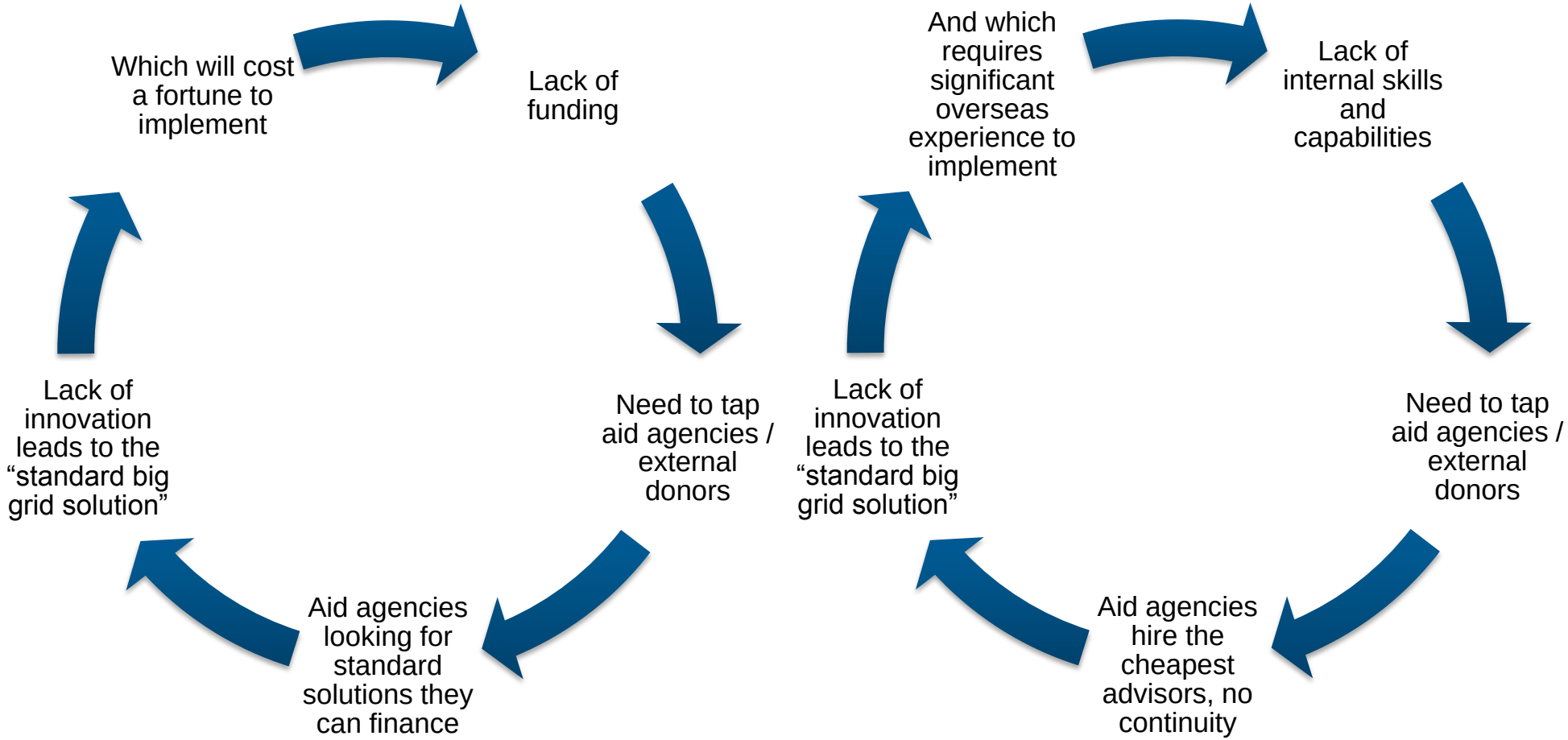
People Centred Energy Policy

- The theme of this conference is “People Centred Energy Policy”
- But isn’t all good energy policy focussed on the people it is meant to serve?
- Perhaps… in an ideal world!
- In the world we live in, policy is driven by:
  - Where can we get the money from?
  - Who will come and implement it?
  - The barriers and constraints of geography, location of natural resources including fuel and the existing infrastructure
  - The capacity and capabilities of those in charge of designing and implementing the policy
  - And of course, politics!

What does this mean in Myanmar?

Lack of funding and lack of experience are driving Myanmar to “standard solutions” – big grid and big power, driven by large international players



It cannot afford to innovate, but can it afford not to?

People Centred Energy Policy should mean the policy that's best for the people

Our definition is:

Least-cost provision of service, consistent with a social intent to meet the needs of each class of consumers

Let's break this down:

"Least cost" – the solution that costs the least to implement in over a number of time horizons, including short term, long term etc. Another way would be to say it is economically efficient.

"Provision of service" – electricity – in the right quantities, qualities to the people and businesses who need it

"Social intent" – focussing on delivering improved lives and livelihoods

"To each class of consumer" – different consumers have different needs and the system needs to address them all

The requirements cover a number of dimensions that have to fit together

What is Least Cost?
- Total cost of the infrastructure?
- Cost per customer?
- Cost per unit of electricity?
- Cost to the national budget per annum?

How quickly can it be implemented?
- Businesses and customers close to the main grid first – working outwards?
- Tackle rural electrification head on?

Where does the money come from?
- Donors?
- Government?
- Customers?
- Someone else? The Tooth Fairy?

Who will implement?
- Aid agencies and donors?
- International private sector?
- Domestic public sector?
- Domestic private sector?

And there are many more!

So where should we start?

The first thing to do for any policy decision, is to frame the issue

Objectives	Constraints	Resource Availability
What is the ultimate goal	What might prevent this from happening naturally?	What resources are available to help and what might be needed?

Is you don’t know where you are going, how can you plan how to get there?

- Having the right objective is a crucial first step in policy formation
- Having the right objective is important, but so is framing it objective correctly
- For example:
  - An objective of “building more power stations” has already closed out many options
  - An objective of “having a sustainable electricity supply industry, which delivers the right amount of power to the right consumers at the right price at the right time” is a better objective to start from
- Once you have such an objective you can see more clearly what needs to be done to achieve it

A sensible objective helps to frame the problem correctly and avoids closing out options too early

So what are the current objectives?

- From a previous conference, I deduced that the objective was currently to deal with the shortages of power and to “electrify the population”
- In addition, the Government wished to do it in a way that:
  - Is as fast as possible
  - Benefits all the people
  - Introduces Good Governance
  - Attracts the best companies
- These are not bad objectives however they are not necessarily all compatible:
  - Doing things well is often at odds with doing things fast, for example
  - “Electrification” per se is laudable, but focus needs to be placed on what electricity is needed for and how much is actually required in the short, medium and longer terms
  - It is hard to benefit everyone at the same time, meaning some choices will need to be made along the way about who gets power first
  - It was never clear that “at least cost” was an objective – and really it should be!

Objectives change as the situation changes

The objective today of "getting more power to more people" is obviously correct given the benefits of electricity and the low current electrification rate…

… but in 10 years time, the objectives might be more focused on how to recover the costs of the system through tariffs …

… and 10 years after that, perhaps "how do we increase the share of renewables and lower carbon dioxide emissions"?

You can obviously change objectives as the industry matures

- Or, with some additional thought upfront, design a more “future-proof” industry from the beginning
  - Focusing on economic, least-cost choices at all stages of development
  - Ensuring consumers pay cost-reflective prices from the start
  - Including the full costs of all options in evaluations – including the opportunity costs of fuels

The best outcomes come from making good decisions. Good decisions require a clear objective, information and objective analysis. A lack of time, money and skills may hinder decision making; but prioritising good decision-making early will save time and money in the long run, as well as building skills that add value in many areas.

Constraints – Or - What might prevent this from happening?

- Obviously, the constrains link to the actual objective
- But some of the obvious issues include:
  - Untested legal and regulatory framework for the electricity industry
  - Unclear policy directions (multiple government departments covering energy for example)
  - Residual concerns about sanctions / governance by potential investors
  - Availability of capital
  - Level of skills available to plan and implement solutions
  - Ability of consumers to pay full costs of electricity
  - Very low level of existing infrastructure

Resources: What are available and what are needed?

- Myanmar does have the one resource that many countries lack – plentiful fuels. It has a wide range of different fuel options.
  - However, where many fuels exist, the question is raised as to which fuels to use for domestic electricity, which for exported electricity, and which to export as fuels themselves. There are a number of tradeoffs needed.
- The most obvious resource needed is money
  - Government money, aid money or private sector money?
  - This is not a simple question as a mix of all three will introduce additional complexities
- Next is skills
  - Most developing countries focus on technical skills – building things
  - But planning, designing markets, regulating and overseeing policy are also necessary skills to set the industry up on the right foot
  - But skills can be learned so fall more into a current constraint than a real lack of resource

Some of the implications of the desire for speed may have unintended consequences

- We understand that some power station developers start building BEFORE they have a final PPA
  - This is very uncommon internationally, as it puts a very large risk on the project
  - Developers that do this may 1) very small or 2) be financing by equity or 3) have some Government backing
- Financing by equity is very expensive – equity costs more than debt – so power stations may be more expensive if done this way
- Some companies that take this risk may be Government owned… particularly Chinese companies … and there are hidden costs to Myanmar in accepting this "help".
- The "best" companies will not accept this structure … if Myanmar wants to attract the best companies at the lowest cost, it needs a good structure in place

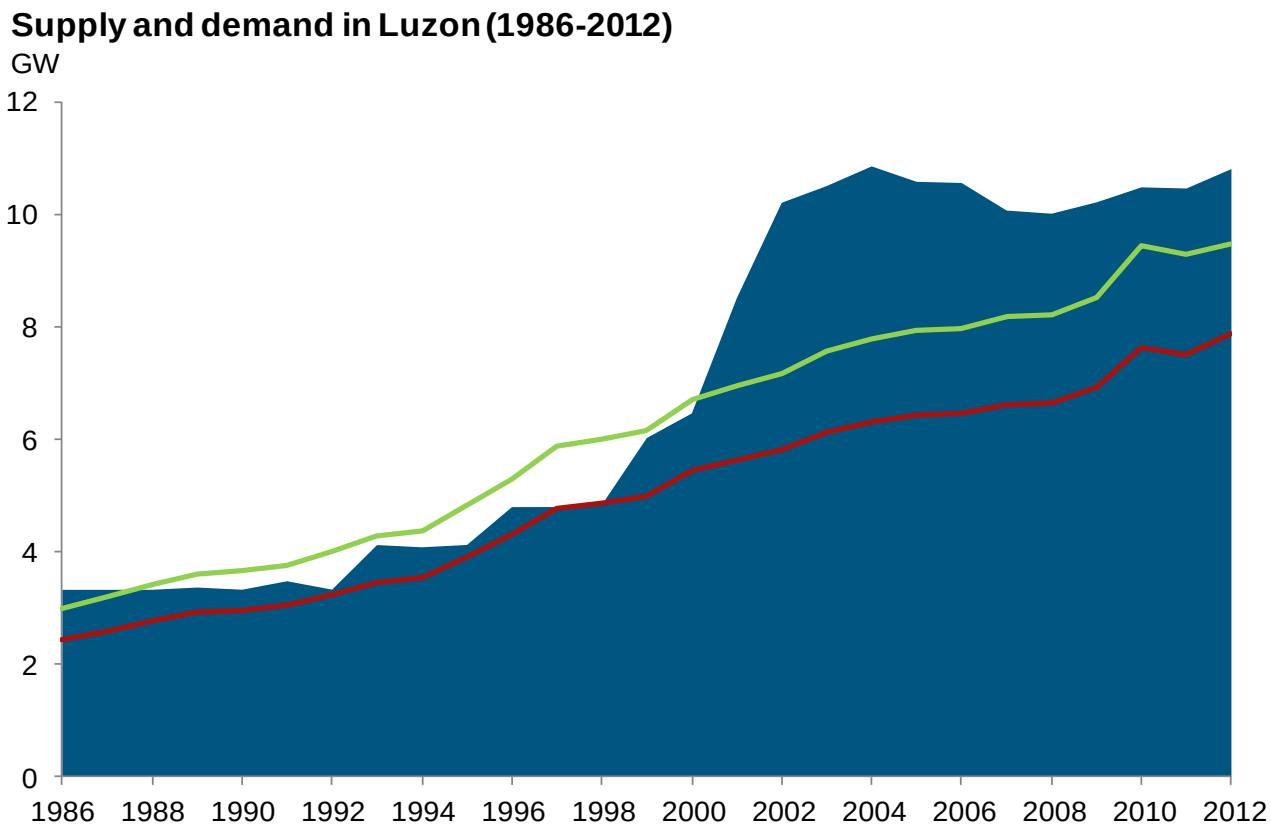
Running rather than walking does not help if you are running in the wrong direction

But Myanmar is not alone is striving for a better future, as fast as possible

- Plenty of Asian countries have done this, many are still paying for their mistakes
- The good news is that you do not need to experience the problems oneself to learn from them – and there are plenty of lessons to be learnt

Poor decision making results in the wrong infrastruture, or the wrong amount of infrastructure, being built

- The Philippines turned to IPPs to try to solve the looming power crisis in the 1990s
- By 1998, foreign-owned IPPs had build **4,800MW** and invested US$6 billion
- But, just as the Asian financial crisis took its toll and demand flattened, **2,700MW** of natural gas-fired generation came online



And poor decisions ultimately cost a lot of money

- This meant that the government, through the National Power Corporation (NPC), quickly racked up debt, which accumulated to **US$22.35 billion** by the end of 2003
- Despite raising about **US$10.2 billion** from privatizing assets and contracts between 2007-11, Filipinos have only really just begun paying off these debts …
  - *Directly* through separate Universal Charges levied on every kWh consumed, currently PhP 0.1938/kWh (about 4.25 Khat per kWh), and
  - *Indirectly* through higher power prices to consumers by burning the wrong fuel

As an example, between July 2007 and Dec 2013, Meralco alone spent an extra US$300m on its gas-fired IPPs compared to the cost saving it could have got from its coal IPP

So far we have identified that we need to

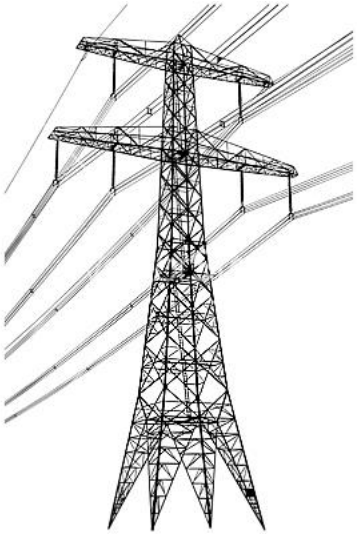
- Clearly define the objective
- Identify constraints and resources needed
- Know where you are starting from

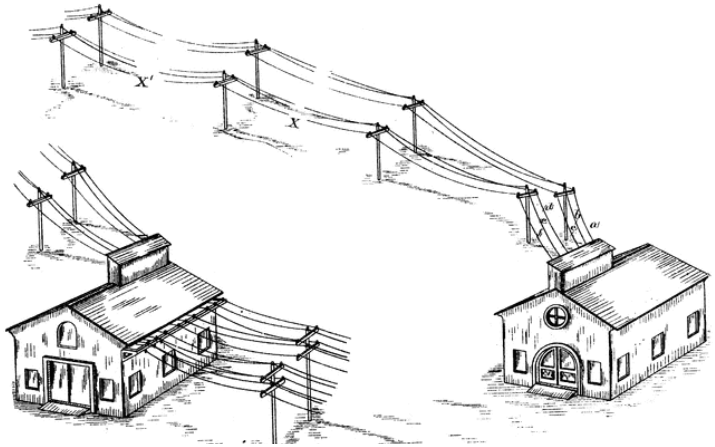
The next section reviews how to decide where to go next

- Plan how to meet the objective
- Then implement.

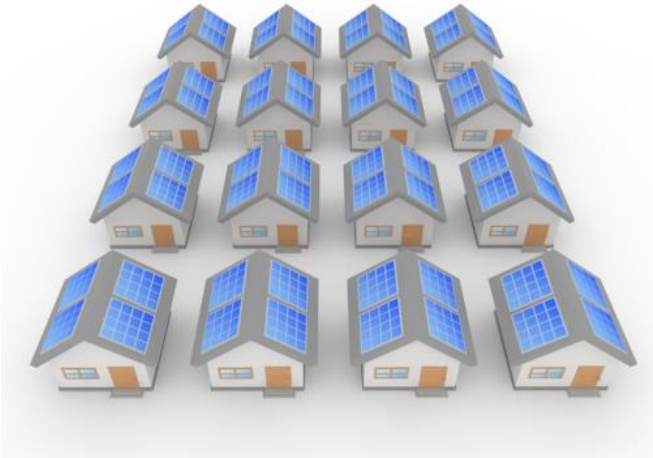
So – what should be implemented in Myanmar?

- This?





- Or this?



Just because everyone else has a grid, does that mean Myanmar should too?

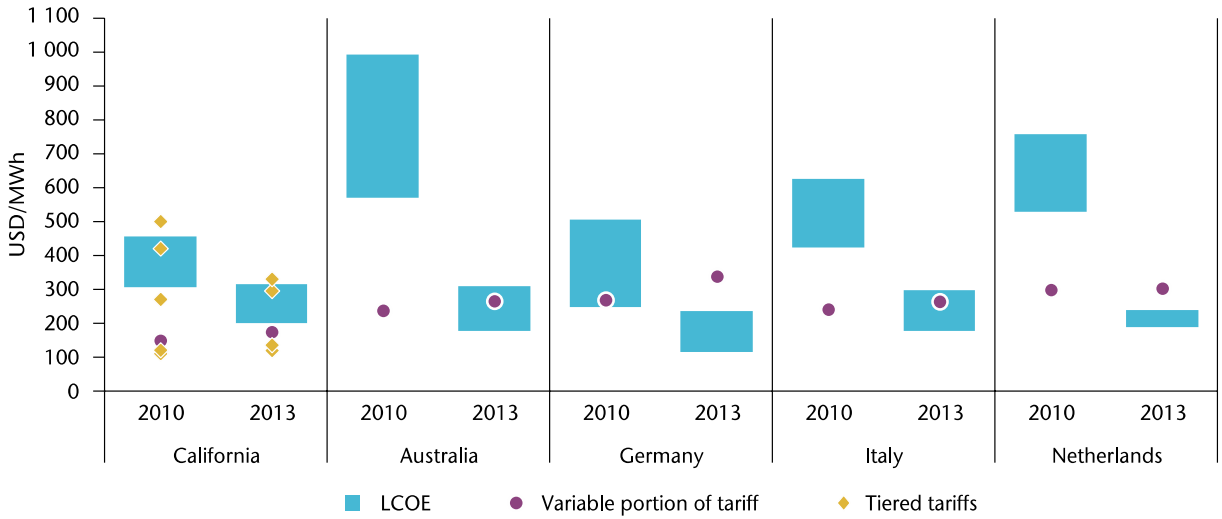
- Most countries aim for a “traditional” grid system
  - Large (100MW and up) power stations located close to the fuel
  - A backbone of transmission lines linking the power stations with the major centres of demand
  - A network of smaller distribution lines connecting each customer with the transmission system
- However, these systems were installed at a time when:
  - There were very large economies of scale associated with generation
  - There were no small power stations
  - There were no economic renewable options, such as wind, solar, geothermal or micro-hydro
  - Reciprocating engines were dirty, unreliable and inefficient
  - Battery storage did not exist

Assuming a traditional grid is the only answer ignores the changes in technology since the 1940’s

A recent IEA report suggests that a number of countries have met "grid parity" with solar PV

- Developed countries are grappling with the risks of grid parity for distributed renewables because of the risk of obsolescence for the grid

Figure 4: Grid parity was reached in 2013 in various countries



Note: Household electricity tariffs exclude fixed charges. LCOEs are calculated using average residential system costs (including value-added tax and sales tax in where applicable, and investment tax credit in California); ranges mostly reflect differences in financing costs. The tiered tariffs in California are those of Pacific Gas and Electric. Tiers 3 to 4 or 5 are tariffs paid on monthly consumption when it exceeds given percentages of a set baseline. All costs and prices are in 2012 USD.

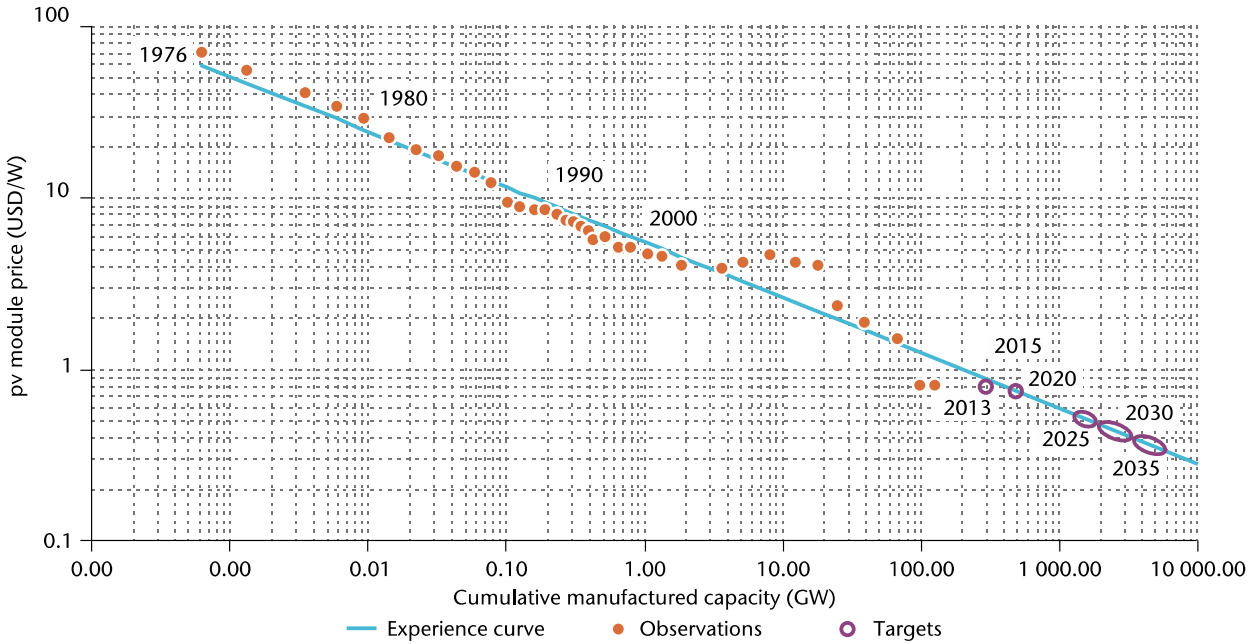
Source: IEA Solar Technology Roadmap

Why build something new if it faces being obsolete in the near future?

Even if not obsolete now, how long will it take?

- The IEA expects solar costs to halve over the next 20 years

Figure 10: Past modules prices and projection to 2035 based on learning curve



Notes: Orange dots indicate past module prices; purple dots are expectations. The oval dots correspond to the deployment starting in 2025, comparing the 2DS (left end of oval) and 2DS hi-Ren (right end).

Source: IEA Solar Technology Roadmap

But one should also note that the cost of a PV system varies hugely around the globe

Table 2: Typical PV system prices in 2013 in selected countries (USD)

USD/W	Australia	China	France	Germany	Italy	Japan	United Kingdom	United States
Residential	1.8	1.5	4.1	2.4	2.8	4.2	2.8	4.9
Commercial	1.7	1.4	2.7	1.8	1.9	3.6	2.4	4.5
Utility-scale	2.0	1.4	2.2	1.4	1.5	2.9	1.9	3.3

Sources: Friedman et al. (2014), *Comparing PV Costs and Deployment Drivers in the Japanese and U.S. Residential and Commercial Markets*, February, NREL/TP-6A20-60360; PV-PS IA (2014a), *PV Cost Data for the IEA*, personal communication, January.

Source: IEA Solar Technology Roadmap

- Most of the gap comes from differences in “soft costs”, which include customer acquisition; permitting, inspection and interconnection; installation labour; and financing costs, especially for small systems.
- Generous incentive frameworks in some countries keep prices higher than raw costs plus a reasonable margin.

The way solar has been implemented around the globe has had a big impact on how cost effective it is

Solar PV is only one economic option (slide 1 of 2)

- Improvement of the grid to connect major cities probably makes sense
  - But a very large country-wide grid roll-out may not be economic
- For large scale generation, coal – fired power stations are still the most cost effective form of baseload power – coal is plentiful world-wide and much less volatile in price that oil – linked products such as oil, gas or LNG.
  - Coal makes sense as a medium term option.
- Myanmar has excellent hydro resources:
  - IF these can be sensitively exploited they offer both an electricity export option and a low cost generation resource over the very long term
- Gas fired power stations are efficient and relatively fast to build. They can also be hired.
  - However deciding whether gas is more valuable being burnt in a power station or sold for hard currency is an important question.

Solar PV is only one economic option (slide 2 of 2)

- Micro-hydro in places where the geography is suitable may well be a sensible basis for distributed generation – another medium term option
- Solar PV with storage may be most practical for the most isolated regions where the alternative is currently diesel –
  - solar can potentially be implemented very fast
- If the wind resource is good, hybrid wind schemes may also make sense –
  - wind can also be built relatively fast.

Clearly there are numerous potential options, over a variety of time frames and geographies

However, the question of exactly what should be done is less obvious

- Money is like any other scarce resource and should be rationed appropriately. However the key is to think through what is needed and make good decisions upfront rather than tackling the problem using the status quo
- Focus on where the most benefit can be achieved for the least cost
  - Which requires a clear framework for identifying "benefit"
- Save money wherever possible using optionality and flexibly size assets
- Optimise the timing of spend
  - There is no point building a transmission line too far in advance of the power station whose load it will carry; and visa versa for the power stations
- Use "out of the box" thinking to lower costs and achieve benefits – even if these are not the "traditional options" or the "way things are done in other countries"

Unfortunately, novel approaches are often hard to finance even if they are the best solution

There are already developers trying to develop distributed solutions but they face a number of difficulties

- Each mini-grid needs analysis to identify the right technology, agree where and how the panels or micro-hydro or windmills or wires would go, who will be connected, agree the tariffs and how money is to be collected etc
- They are being driven by the private sector – who need to do detailed due diligence and cost-benefit analysis before they proceed
- But each distributed mini-grid is very small – a lot of effort has to go into a small system, meaning that upfront costs (not just for equipment) are high
- The same problem applies to funding – few sources of funding are available and those that exist require a detailed business case for each (tiny) investment

CONVERSELY, Grid expansion is typically done differently

Grid expansion internalises social benefits and spends less time looking at costs

- The costs of a grid are spread over the whole connected region. There is far less analysis of the "cost-benefit" of each incremental additional connection, because it is well understood that incremental additions are often negative
- Typically, central utilities are required to connect (over time) and there are subsidies in place to allow these non-economic incremental additions to take place
- Because the funding comes from Central Government (or from aid agencies) for "the big picture", far less analysis and due diligence is done on every village (less work)
- Funding comes at a lower cost of capital, allowing cost recovery over a longer period
- And what is done, is done by employees of the utility, not by the private sector or consultants (lower cost)

"Grid electrification" is a social endeavour, subsidised and supported by Government and Aid Agencies. Until distributed electrification is treated in the same way it will always be at a disadvantage

To achieve the optimal mix of grid and off-grid development, new thinking will be required

- How can policy be designed to encourage home-installations; small mini-grids, fast track IPP's **and** the most cost effective larger grid infrastructure and power stations?
- How can the regulatory and policy frameworks be designed so that no cost-effective options are overlooked or discriminated against?
- Where is the money (limited resource) best spent?
- What are the best options for Myanmar's indigenous resources (fuel)?
- What training and capacity building will result in the most effective improvements in technical skills?
- Be sure the advice you are getting is unbiased and independent, and in the best interests of Myanmar and not the person paying for the advice

Think first; act later. Set up frameworks to set the scene for the future avoid closing out sensible options

Economic analysis can help – provided the real objectives and constraints are clearly defined

- Economics is about maximising utility when you have limited resources
  - Choosing which options have most benefit
  - How to ration resources
  - How to maximise utility (or benefit) from what is available
  - How to use optionality and flexibility to keep

A clear economic framework can assist in decision making and critical thinking

A good, economic framework for the energy sector in Myanmar would

Have an over-arching policy which:

- Encourages innovation
- Fosters an environment where decisions are open, transparent, based on sound analysis and consultation (without being bogged down in bureaucracy)

Have a regulatory environment which:

- Rewards good decisions and allows the impacts of poor decisions to flow through to the decision maker (and not the customer)
- Does not penalize good decisions that happen to have bad outcomes (luck is a factor)

Is implemented by companies and government departments that

- Question each decision
- Review each investment for efficiency, appropriateness, size and timing

In summary

- Good outcomes generally result from good decisions
- Good decisions:
  - Require a clear framework
  - Benefit from good data and information inputs
  - Are a product of good analysis
  - Should require the investor to take some of the risk of the outcomes
- The best advice for the development of the energy sector in Myanmar is to set a policy and regulatory framework for good decision making
- And allow the decisions made under that framework to guide development