



Key Messages

- Stress in power sector is going to remain an ongoing problem for the next decade
- Currently, the stress is concentrated in private thermal generation and distribution sector
 - > It has led to spill over and distress in Public Sector Banks and NBFCs
- Going forward, onset of renewables is going to exacerbate this problem for thermal generation sector
- Distribution Sector stress, if it continues, can slowdown the renewable energy growth and have severe impact on Indian economy
- Three things need to happen
 - Realize the scale and enormity of the problem
 - Realize there are no magic bullets and solving it will be a long drawn process

Stress in Power Sector

- Get serious about solving it
- Co-operative Federalism is the go to strategy





Stress- The Slow and Silent Killer

- Frequent onset of the stress response, can have devastating consequences. It can lead to an increasing risk of adult diabetes, high blood pressure and several gastrointestinal disorders.
- There are two kinds of stress:
 - Acute stress- results from situations that are new and have never been faced before
 - Chronic stress- results from the repeated exposure to a particular situation. This kind if stress is the most detrimental
- Chronic stress causes our body to be out of sync and can lead to a domino/ cascading effect of several health problems such as cardiovascular disease, truncal obesity, insulin resistance and type 2 diabetes, high cholesterol and the impairment of the human reproductive system.

Stress in Power Sector



Robert Sapolsky has written several books including Why Zebras Don't Get Ulcers, his insights are based on several years of field experience with wild African baboons. According to him, Baboons are the most similar to human beings, having no real stressors in their lives



How to Identify Stress?

A condition in which a firm or an individual cannot generate revenue or income because it is unable to meet or cannot pay its financial obligations due to:

High fixed costs

Illiquid assets

Revenues sensitivity to economic downturns

Chronic Stress	Acute Stress			
 Balance sheet Decline in working capital as the payables in the account grow at a faster rate than inventory and the receivables (CL>CA) Higher interest repayments as there exists higher risk of defaulting Higher debt to equity ratio (D/E>1) If ICR <1 then companies' payment credibility is questionable and implies that company cannot cover its interest with the earnings in the current period 	Liquidity 1. Lack of marketability of an investment that can't be bought or sold quickly 2. Cannot meet short term debt obligations 3. Lack of convertibility of assets into cash Cash Flows 1. Negative cash flows over a sustained period of time			

Stressed Assets

Stressed Assets =

NPA

Restructured loans

Written off assets

A loan whose interest and/or instalment of principal have remained 'overdue ' for a period of 90 days is considered as NPA.

Stress in Power Sector

Restructured asset or loan are that assets which got an extended repayment period, reduced interest rate, converting a part of the loan into equity, providing additional financing, or some combination of these measures.

Written off assets are those the bank or lender doesn't count the money borrower owes to it. The financial statement of the bank will indicate that the written off loans are compensated through some other way.



What are different definitions of Stressed Assets?



RBI definition

Stressed assets result from principal or interest payment or any other amount wholly or partly overdue between 1 and 90 days



Interest Coverage ratio (ICR)

ICR = EBIT/ Interest expense.

It is used to measure the company's ability to meet its debt obligations and interest payments.

If ICR <1.5 then companies' payment credibility is questionable and implies that company cannot cover its interest with the earnings in the current period



IEA definition

Investment in fossil fuel-based assets, as a result of changes brought about by climate policy that do not recover all or part of their investment during the time that they are operational.



Consequences of stress at individual and macro level- How the Twin Balance Sheet Crisis can spawn into a full blown depression

First round

Business doesn't remain viable, profits and investments drop- Hope for economic recovery or tighten expenditures is the only way

Second round

If stress continues then it spreads to the business partners involved-vendors and suppliers, employees and creditors. Now they have to tighten their belts to survive

Stress in Power Sector

Third Round

If this contagion spreads then GDP growth slows down or turns negative, due to excess supply and reduced demand – prices start falling, capital outflows start. If this continues then deflation sets in. Even worse deflation expectations get anchored

Final Round

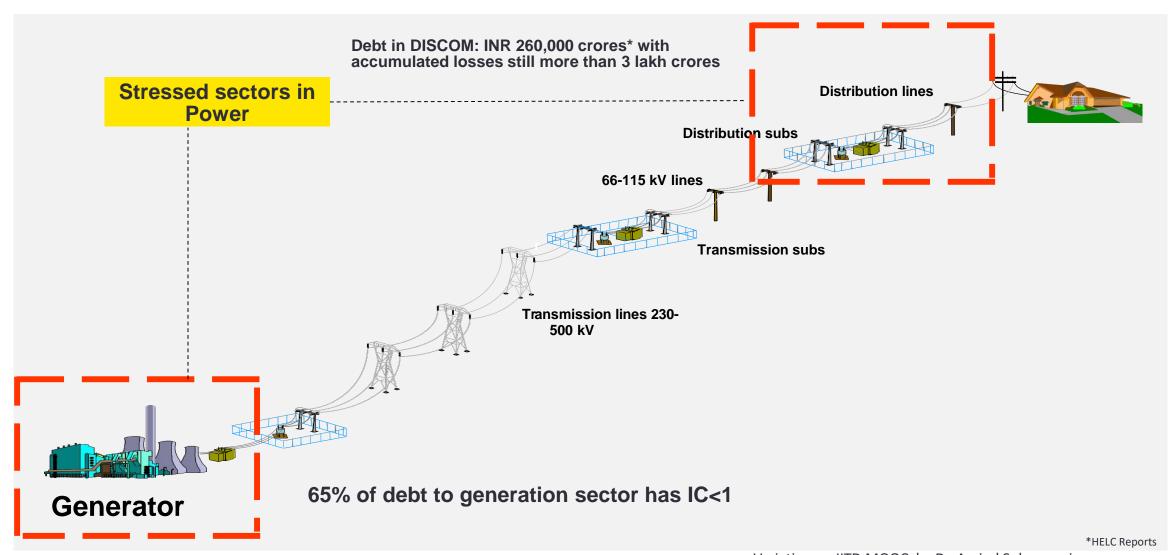
- Deflation expectation further curb demand, Crisis of confidence freezes the financial system and
 Depression level situation arises. Think of 1929 and more recent 2008 crisis here
- Inherent counteracting forces exist and the economy can have multiple equilibriums
- Monetary policy has to respond





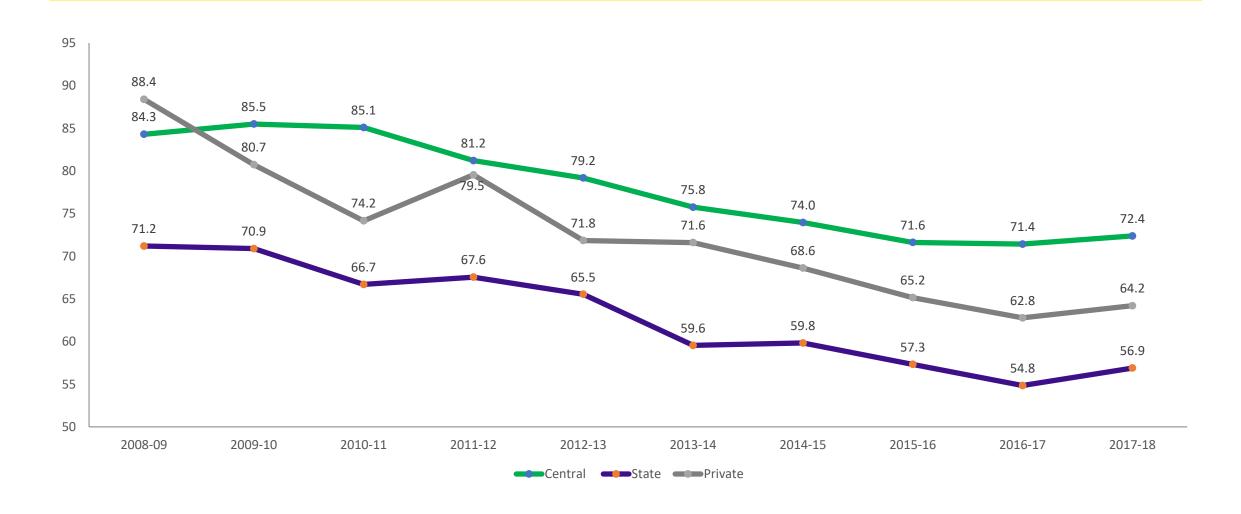


Both Upstream and Downstream sectors are under severe chronic distress





Steady Decline in the capacity utilization with Private sector faring worse

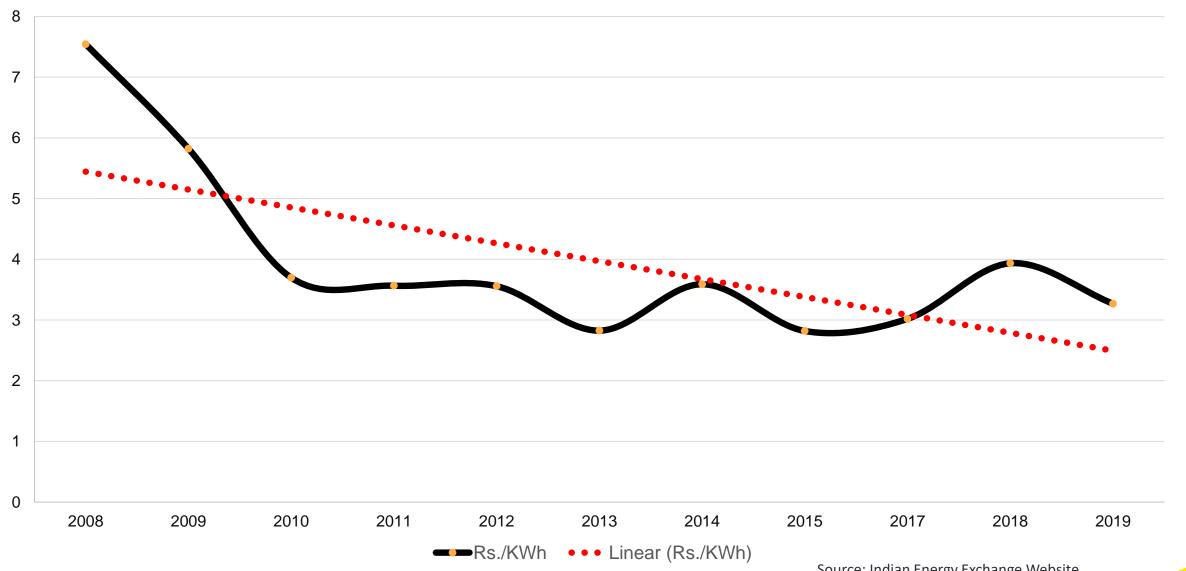


Stress in Power Sector

Source - CEA



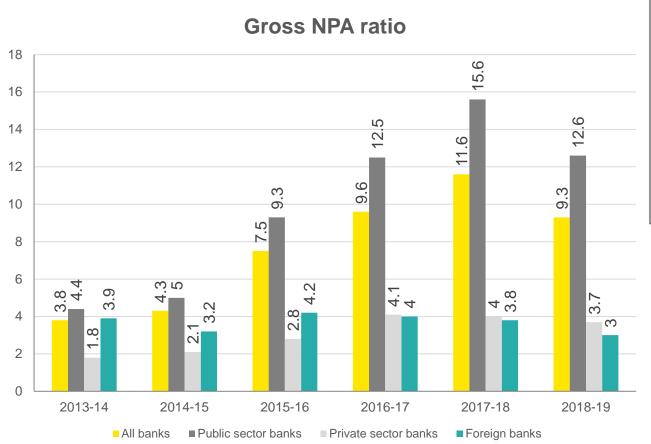
Marginal prices discovered through Day Ahead Market have also seen a steady decline

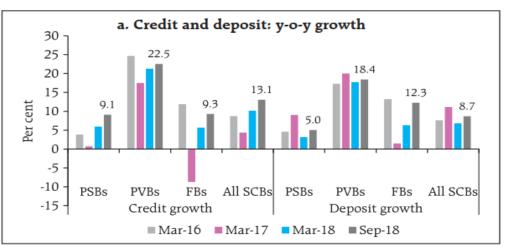


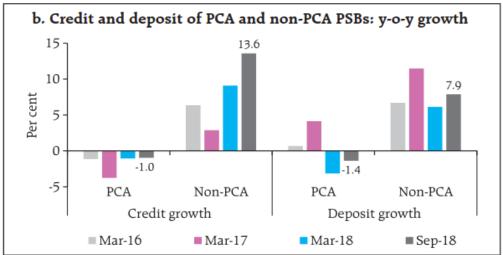
Stress in Power Sector



Banking Sector under a slow bleed for last 7 years





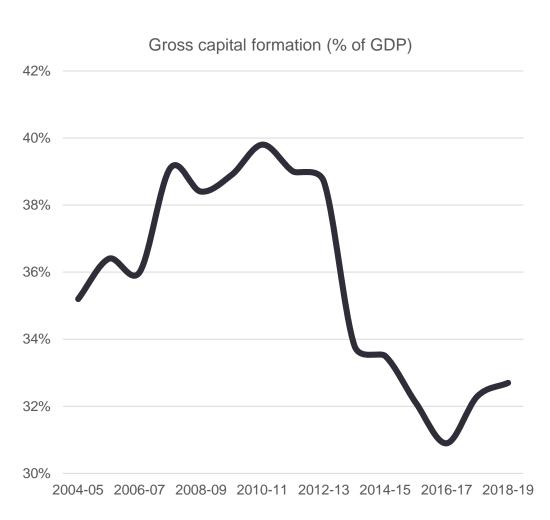


Source: RBI Financial Stability Report, June 2019

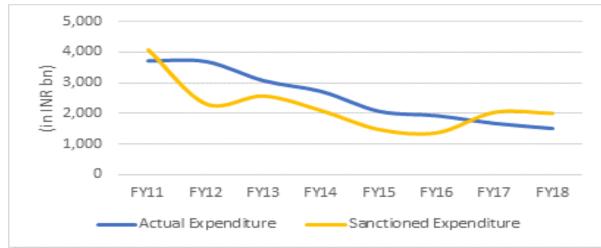


Economy wide slowdown in Investments and Capacity Utilization

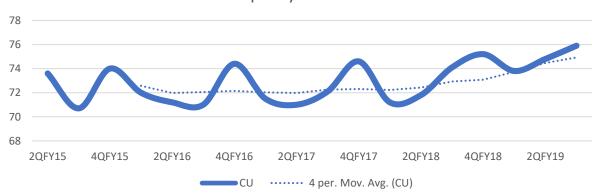
Stress in Power Sector



Capital expenditure funded through formal financial sector



Capacity Utilization



Source: CSO, RBI and IMF



Reasons for Power Sector Stress: The elephant in the room

"Happy families (unstressed assets) are all alike; every unhappy family (stressed asset) is unhappy in its own way."



Supply of fuel



Judicial delays



Low capacity utilization





Fixed Cost Debt



Irrational exuberance



High Real Interest



Operational inflexibility of the plants



Technological Risks



Railways



Regulatory roadblocks



Frauds



Economic downturn



Market Factors



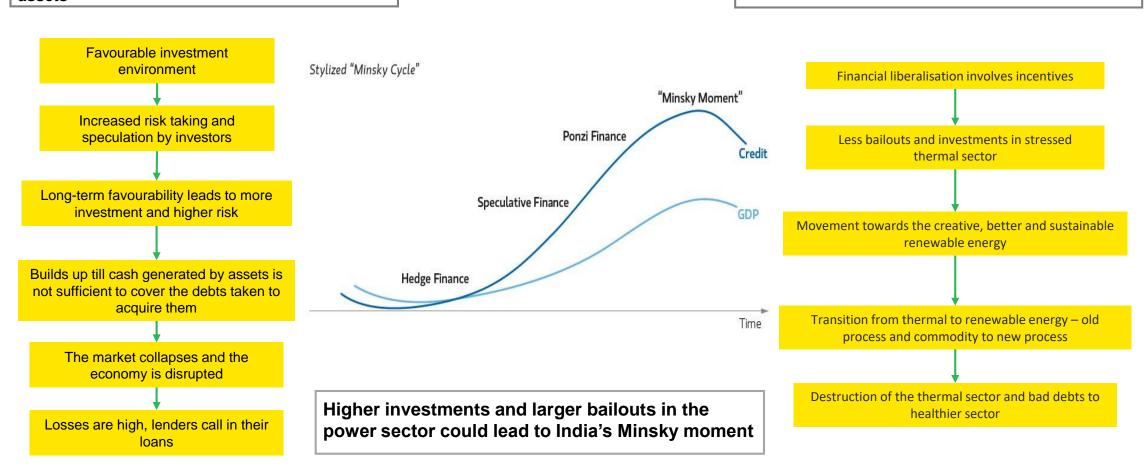
Unknown Unknowns



Minsky Moment + Creative Destruction

Generation of a credit cycle or business cycle due to a collapse in the values of different assets

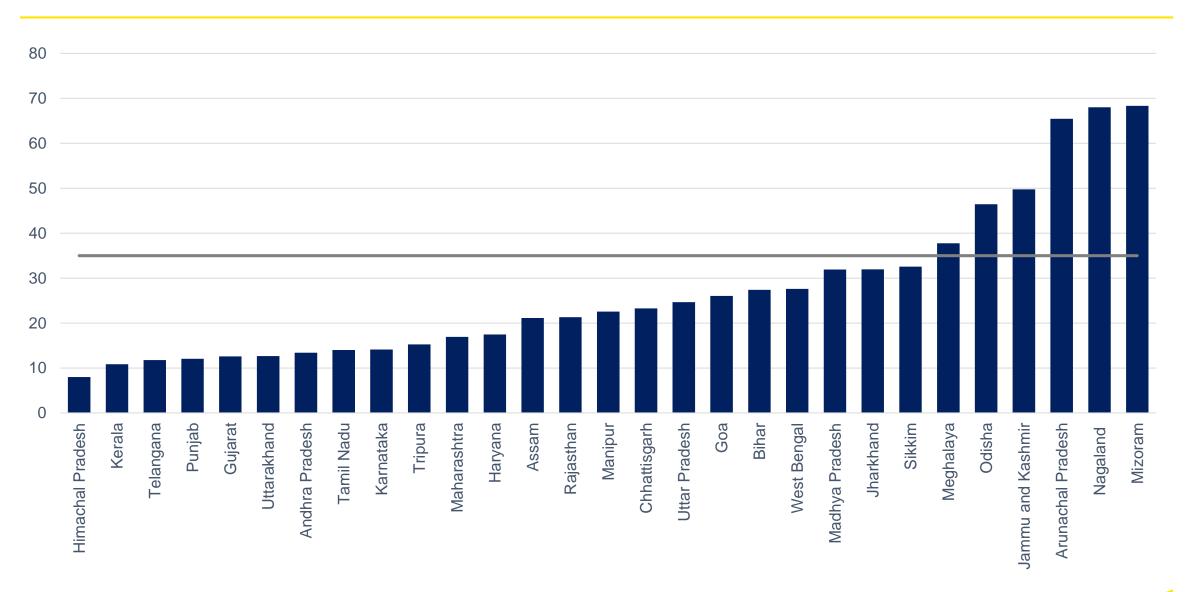
Thermal energy sector falls in with Schumpeterian vision of 'gale of creative destruction'.







Discoms stuck with high Aggregate Technical & Commercial Losses





Achilles heel of the whole value chain – Distribution Sector



Distribution is the power sector's direct interface with the public. It is the Achilles' heel of India's power sector.

All the costs incurred in supplying power, including generation, transmission, and distribution, are recovered from the retail tariffs charged by the distribution company (DISCOM) to its customers

- Distribution companies have mainly two functions:
 - Maintaining the network (the wire business)
 - Procuring power to ensure supply (the supply business)
- Distribution companies follow a supply oriented approach to planning; planning for purchase was thus adding to base load capacity through long term power purchase agreements
- Chronic problems faced by DISCOMs:



Source - Prayas (Energy Group) Electricity Distribution Companies in India: Preparing for an uncertain future, May 2018



Problems in Distribution Sector... Portfolio Optimization gone wrong

Major causes of distress:

Issue with power procurement

- ▶ 80% costs due to power purchase
- High cost of generation
- Flawed planning

Operational efficiency

- Persistent AT&C losses
- High operations and maintenance expenses
- Inefficiencies in capital expenditure

Skewed tariffs

- Subsidy to agriculture and other consumers
- Excessive cross subsidy

Possible impact of renewable energy on DISCOMs;

- For many DISCOMs, the average cost of power purchase is above Rs. 3/kWh and it is increasing every year
- However, new solar and wind capacity is available at less than Rs. 3/kWh, with tariff remaining fixed for the next 25 years
- Therefore, capacity addition in the future is likely to be less expensive than the long term capacity currently contracted, if DISCOMs transition to renewable energy

State DISCOM	Backing down reported (MW)		to backing	Fixed-cost for backing down as a % of fixed cost payments to generators	backing down as a
Rajastan	1798	14%	1051	16%	59%
Punjab	3457	27%	3006	33%	51%
Maharashtra Madhya	4231	19%	2828	21%	59%
Pradesh	2444	17%	2177	28%	40%
Gujarat	5525	30%	3823	36%	104%



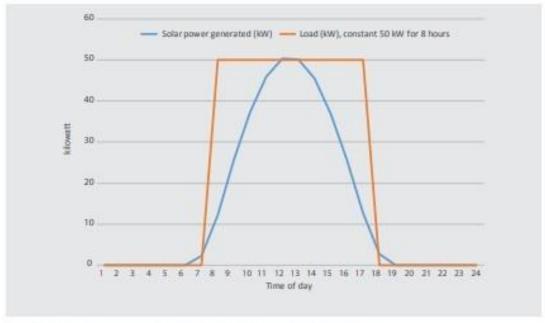
Distribution Sector – Strained Cross-subsidy model

- The distribution business is based on a 'cross-subsidy' model wherein some consumers are charged tariffs higher than the average cost of supply (ACOS) whereas agricultural and small consumers pay a tariff that is much lower than the ACOS.
 - The 'subsidy' thus received from the higher tariffs charged to large consumers is referred to as cross-subsidy.
- In addition to such cross-subsidy, the state government may allocate explicit revenue subsidy for agricultural pump sets, below poverty line (BPL) households, and a few other consumer categories.

Issues:

- The increasing ACOS and falling prices of renewable energy are making the 'non-DISCOM' supply options such as renewable-energy based open access and captive consumption more economical and technically feasible
- Given the economic incentives, the high-paying consumers are likely to opt for such non-DISCOM options leading to loss of sales and hence of the cross-subsidy revenue for the DISCOMs

Figure 5: Using solar to offset major part of daytime load

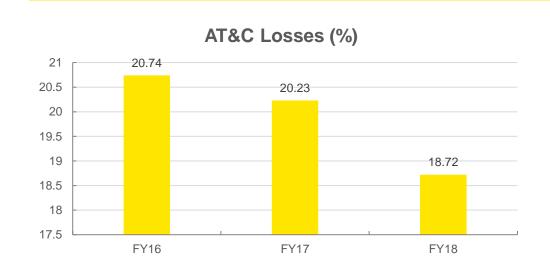


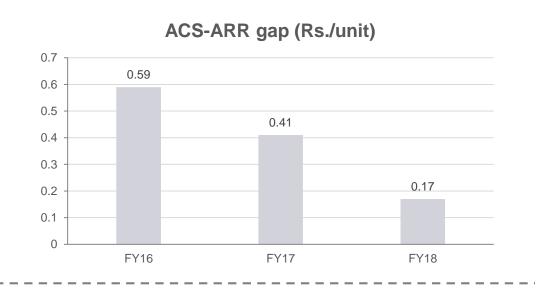
Note: Solar output shown here has been simulated for an indicative site in central India.



Unaudited UDAY numbers show an improvement

Stress in Power Sector





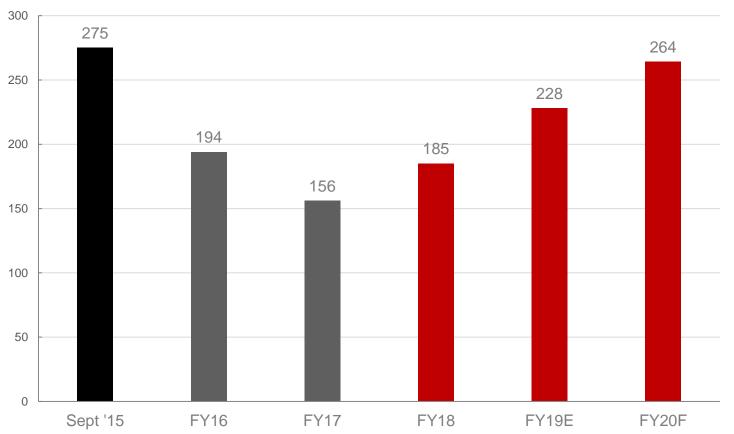
Power Purchase cost (Rs/unit) 4.24 4.23 4.23 4.22 4.21 4.2 4.2 4.19 4.19 4.18 4.17 FY16 FY17 FY18 Source - UDAY Dashboard

- Post launch of UDAY programme, AT&C losses have been consistently declining and were brought down by 2% from 20.74% in FY16 to 18.72% in FY18.
- Power purchase cost has almost remained same since FY16, due to cost reduction measures taken by DISCOMs
- ACS-ARR Gap reduced by Rs. 0.42/unit



However, debt overhang still stays?



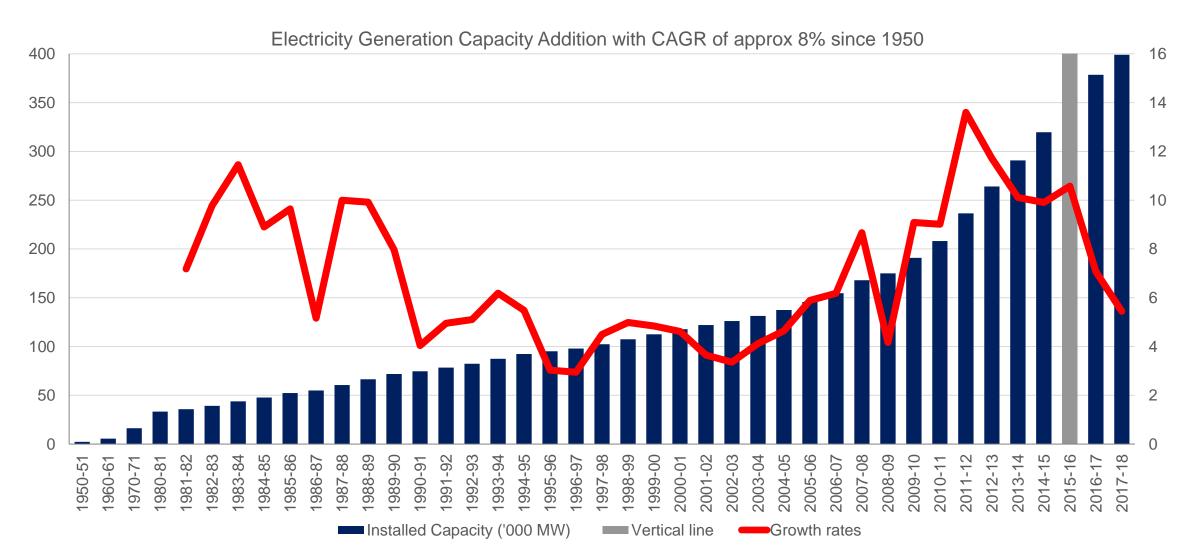


- Aggregate debt of state-owned distribution companies is set to increase to Rs.2.6 lakh crore by the end of this fiscal year
- Supposed to initiate structural reforms by the reducing AT&C losses by 900 bps but reduced only by 400 bps
- Average tariff increase was supposed to be 5-6% but increased only by 3%

Source: CRISIL ratings



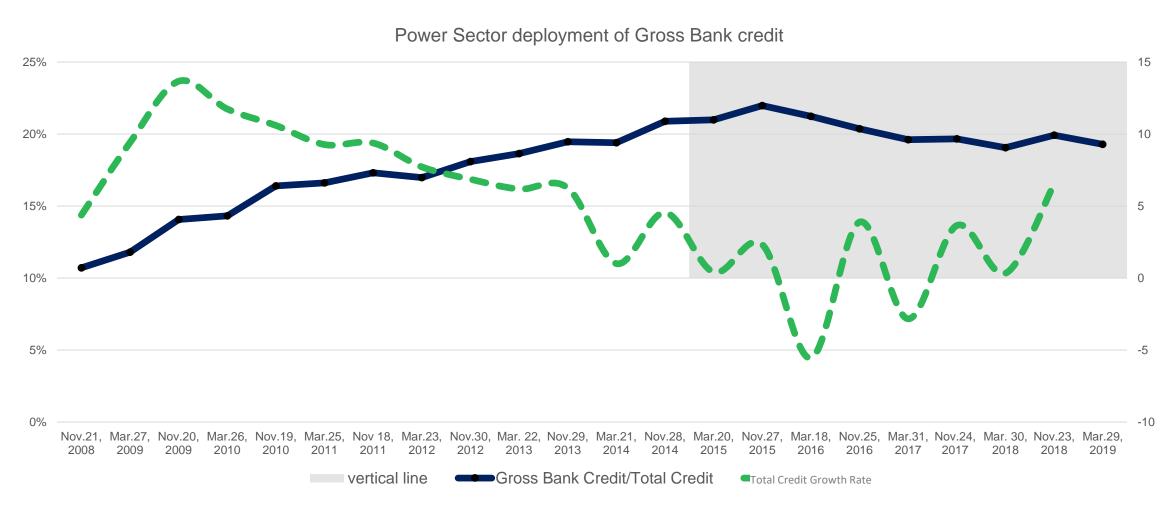
Electricity capacity addition





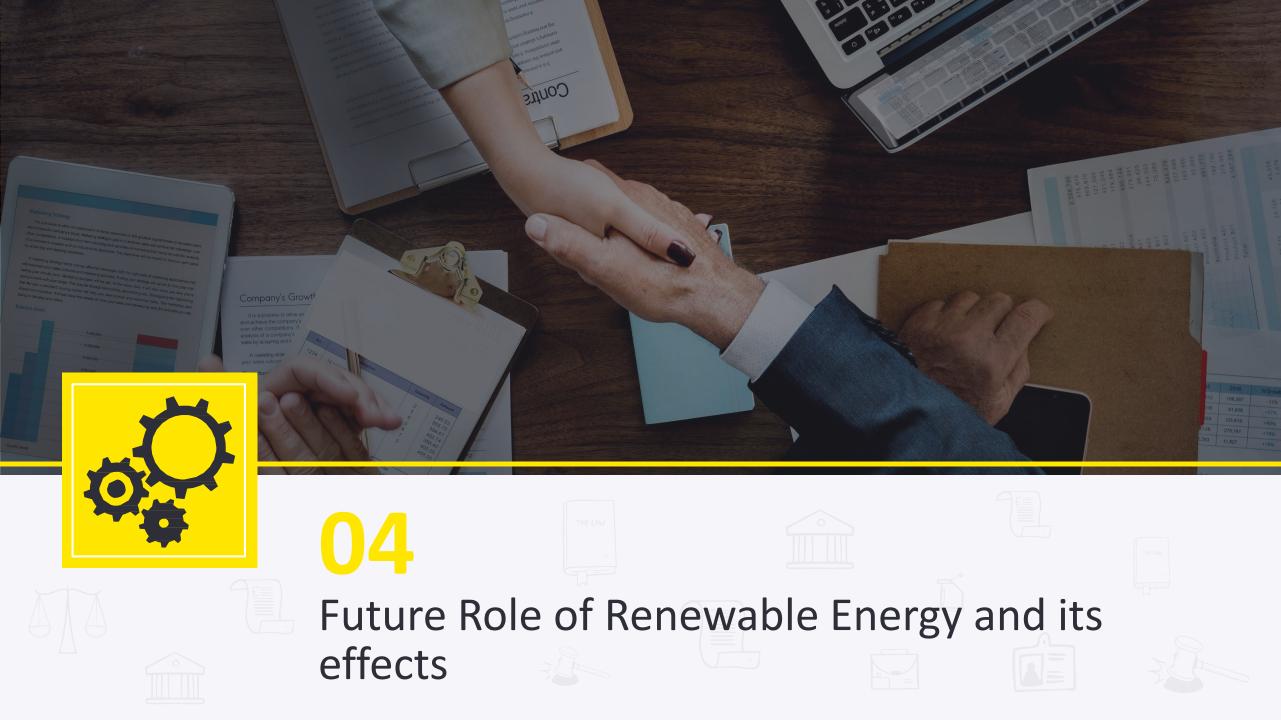
Power Sector deployment of Gross Bank credit

Stress in Power Sector

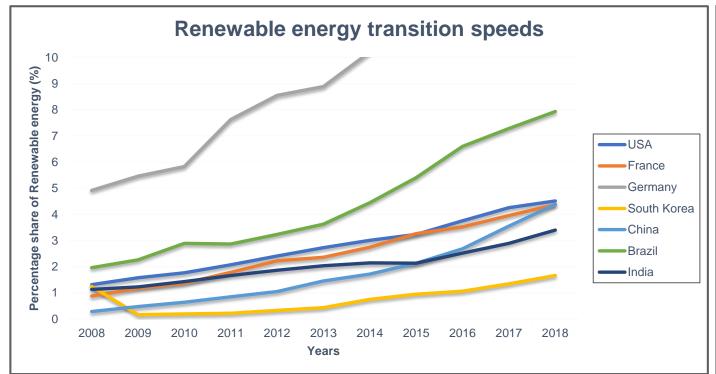


Source: RBI Database





Global Renewable Energy penetration – BP Energy Report 2019



Percentage of RE in primary energy consumption (%)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
USA	1.31	1.58	1.77	2.07	2.41	2.73	3.01	3.23	3.76	4.25	4.51
France	0.88	1.17	1.37	1.78	2.22	2.36	2.75	3.27	3.52	3.96	4.37
Germany	4.92	5.46	5.82	7.62	8.55	8.88	10.21	11.91	11.67	13.30	14.60
South Korea	1.24	0.16	0.19	0.22	0.33	0.43	0.75	0.95	1.06	1.35	1.66
China	0.29	0.47	0.64	0.85	1.05	1.45	1.72	2.13	2.68	3.55	4.38
Brazil	1.96	2.26	2.89	2.86	3.23	3.63	4.44	5.41	6.60	7.28	7.93
India	1.13	1.22	1.43	1.66	1.86	2.03	2.14	2.13	2.52	2.89	3.40

Findings

- Renewable energy grew by 14.5%, slightly below its historical average, although its increase in energy terms was close to the record breaking increase of 2017
- Growth in global primary energy demand was 2.9% from last year, the fastest since 2010
- Weather has also affected the energy consumption in 2018 with unusually large number of hot and cold days across world's major consumption centres
- Growth in carbon emissions has been 2%, as a consequence of increased energy demand

45%

China's contribution to global renewables growth which Is more than the entire OECD combined.

76

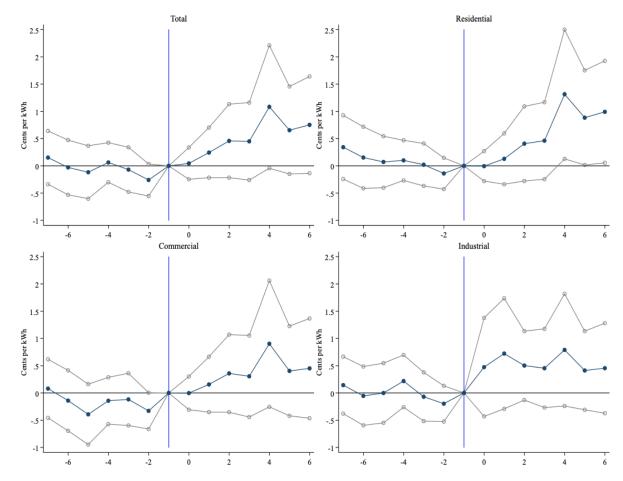
India's rank on the energy transition index 2019 calculated by the World Economic Forum



The Effect of Renewable Energy on the Average Retail Price of Electricity

- Renewable Energy Mandates (REM) raise electricity prices by 11%
- when renewable energy accounts for 1.8% of the total energy and by 17% when the share of renewables is 4.2%.
- Ample space is required to set up renewable energy generators such as a wind mill farm.
- These spaces are usually highly dispersed which adds to the cost of transmission of energy.
- The integration of renewable energy results in an excess of installed capacity that renders existing baseload generation unnecessary.
- The decommissioning of generators and the associated costs of stranded assets have to be borne by distribution companies, generators, and ratepayers.
- Even though negative prices of electricity may exist retail electricity rates may rise to adjust these stranded asset costs.
- Solar and wind energy generators do not provide a constant supply nor can they respond to variable electricity demands. Some sort of back up has to exist until sizeable storage methods can be developed

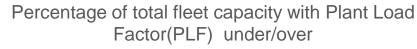
Figure A.4: Electricity Prices Before and After RPS Passage, by Sector

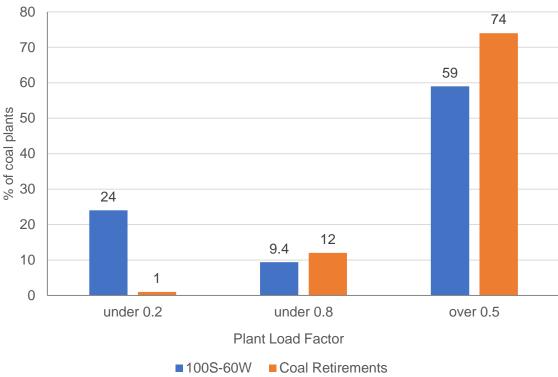


Source: https://bfi.uchicago.edu/wp-content/uploads/BFIEPIC WP 201962 v4.pdf



What will be the impact in India? -NREL Greening the Grid Study-2017





50% to 62%

Increase in coal fleet's average PLF after retirements of low-PLF plants by 2022.

Otherwise it will stay below the technical minimums for coal generation

Policy directions and implications

- Improved RE integration will be costly because it requires expensive transmission expansion so institutional support needs to be provided
- Renewable energy targets of 175 GW are achievable, and continued investment in both interstate and intrastate transmission will help facilitate these targets
- Reduction in information asymmetry (e.g., costs, generator availability) to enable more coordinated dispatch
- Modifying the minimum generation levels of all coal plants will be important for RE integration but it will come at a cost of greater and wear on the plants
- Payment of fixed tariffs will exist even though plant load factors decline reducing the incentive for plants to provide RE services and transitions
- Economic optimization (cost minimization) is required in power system operations and planning as in some case RE curtailment is cheaper than avoided shutdowns. It also boosts the confidence of RE investors



Possible dynamics of the renewable integration: The Green Paradox & Failure of Policy

As first proposed by Hans-Werner Sinn and later described in a research paper*;

- A weak green paradox exists when the rate of extraction of fossil fuels increases rapidly in anticipation of the tightening regulations and stricter enforcement of new climate policies. This leads to global warming acceleration.
- A strong green paradox exists when the present value of the costs of global warming, in terms of reduced output, falls in anticipation of tightening climate policy.

Government failure arises when carbon taxes are not imposed rather renewable energy and renewable plant components are subsidized

Effect of a carbon tax

A high rate of increase of carbon taxes not in sync with the rate of increase of interest can disrupt the equilibrium price path of fossil fuels. One of the consequences of this is the higher rate of extraction due to the steeper price path. Carbon emissions will rapidly increase until an equilibrium price path is reached. The enforcement of this policy will not limit carbon emissions and is counterproductive. Alternately if carbon tax grows at a smaller rate than the rate of interest then global warming and oil extraction will occur less quickly.

Effect of subsidies

If the costs of renewable energy are reduced due to a technology breakthrough or subsidies being imposed on the technology during the gradual phase out of fossil fuels, the equilibrium price path will become steep resulting in a weak green paradox. This will increase emissions and the rate of extraction.

Source: https://www.economics.ox.ac.uk/materials/working_papers/4844/oxcarrerp2013116.pdf



^{* &}quot;Global Warming and the Green Paradox: A Review of Adverse Effects of Climate Policies", Department of Economics, University of Oxford

Counter narrative IISD-Report on India's stranded assets: Government interventions are propping up coal power

29%

India's power sector burden till March 2018.

India's levelized renewable energy costs are among the lowest in the world

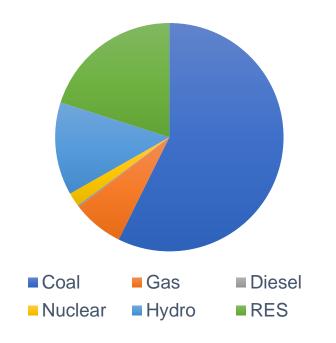
Key drivers of asset stranding

- Cost competitiveness of the renewables
- DISCOM's financial distress and collective debt burden of billions of dollars
- Air pollution regulation
- Water scarcity
- Coal shortages

Government Interventions

- Public finance
- **Subsidies**
- Policy postponement

India's installed capacity mix (%)



Report summary

- The impact of governments interventions in the non-economic coal assets are categorized into public finance, subsidies and policy postponement.
- Identifying the major drivers behind asset stranding in India with emphasis on the poor electricity planning, the de-regulation, excessive risk-taking by promoters and aggressive bank lending.
- The counteracting effect of the interventions and the drivers with inferences on the energy market in India as government is masking the reality of the coal sector.

Source:- India's stranded assets: how government interventions are propping up coal power, IISD Working Paper, September 2018

Counter narrative...IISD Report – Analysis & Findings

Under the UDAY Scheme, central, state and public finance institutions have taken over up to 25% of DISCOM debt

Findings

- Increase in capital expenditures and operating costs in the coal sector as a collective result of the drivers of asset stranding
- Elimination of special fund for renewable energy and reallocation of revenues for compensating state-level losses associated with GST
- Postponements in implementation of new environmental standards are causing avoided capital expenditure costs and additional health costs
- India's DISCOMs can look into lower cost renewable solutions to remedy the financial position.
- Government interventions are supporting the coal power value chain, e.g. subsidies to coal are higher than subsidies to renewables
- Coal power plants are not charged for the cost of water despite the scarcity

Figure 6 Generation losses due to DISCOM low demand and associated reserve shut down (million kWh), financial years 2012-13 to 2014-15

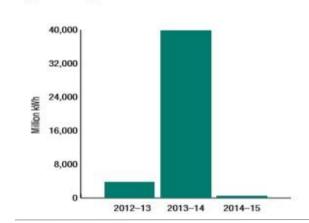


Figure 5 Load factors of coal plants by ownership (central government, state government and private) (financial years 2009-10 to 2017-18)

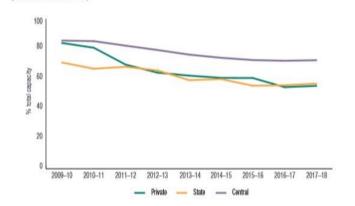


Figure 9 Generation losses due to coal shortage (million kWh) (2012/13 to 2014/15)

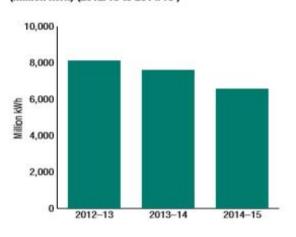
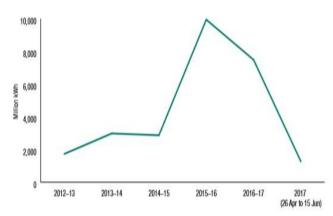
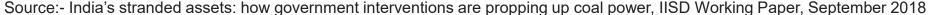


Figure 8 Generation losses due to water scarcity (million kWh) (financial years 2012/13 – June 2017)







Policy Dilemmas: Renewables may be the Future but are they the Present?

Background:

- India is committed of installing 175 GW of renewable energy by 2022.
- An emphasis on renewable energy has resulted in over-expansion, which has led to plummeting plant load factors and lower profitability
- Stranded assets in the power sector can adversely affect the health of the economy already affected by the twin balance sheet challenge.
- Coal mining provides employment to millions of communities and is an important source of fiscal revenue for many states
- Coal is also the cause of the "resource Curse" and the "Dutch Disease". Renewable energy can avoid these outcomes.

Propositions:

- 1. Policies for coal and renewable energy should be decided jointly
- 2. The social costs of coal should include the domestic externalities not the international externalities
- 3. The cost of renewables should be scrutinized. True parity, in social terms, will be achieved only in the future.
- 4. Carbon imperialism of developed countries should not affect Indian policy makers' judgement
- 5. Social costs of renewables should include the costs of the stranded assets due to an already stressed economy struggling with the twin balance sheet challenge.
- 6. Current bids do not reflect the true costs of renewables due to extensive subsidies awarded by the center and the states and the strategies adopted by renewables producers.
- There exists a narrow opportunity for ramping up the extraction of fossil fuels and driving up utilization capacity sharply in thermal power generation.
- 8. Subsidizing renewables despite its high social costs will add the burden of financing stressed assets on the government
- 9. Subsidies will raise challenges on the political/social side and on the economic/financial side
- 10. Technological progress in cleaning coal can help in easing the stress between coal and renewables.

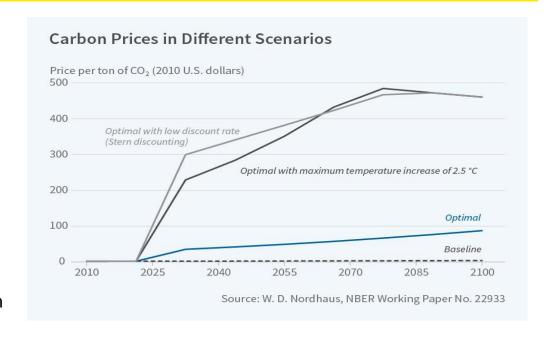




Dynamic Integrated model of climate and the economy simplified

- The dynamic integrated model of climate and the economy (DICE) is a simplified analytical and empirical model that factors in the economics, policy, and scientific aspects of climate change.
- In this model economies make investments in capital, education, and technologies, to reduce present day consumption and increase future consumption
- GHG emissions is negative capital while investments in reduction of GHG emissions reduce this negative capital.
- Objective: DICE is designed to be a policy optimization model with the objective function to maximize the economic well-being associated with consumption.

Scenario	2015	2020	2025 203		2050	
Baseline	30	35.7	42.3	49.5	98.3	
Optimal						
controls	29.5	35.3	41.8	49.2	99.6	
2.5 degree n	naximum					
Maximum	184.1	229	284	351	1008.4	
Max for 50						
years	147.2	183.2	227.2	280.4	615.6	
Stern						
review						
discounting	256.5	299.6	340.7	381.7	615.5	



- Baseline: No climate-change policies are adopted
- Optimal: Climate-change policies maximize economic welfare, with full participation by all nations starting in 2020
- Temperature-limited: The optimal policies are undertaken subject to a further constraint that global temperature does not exceed 2.5 °C above the 1900 average. (The international goal of 2 °C is not feasible with current DICE estimates without technologies that allow negative emissions by mid-21st century.

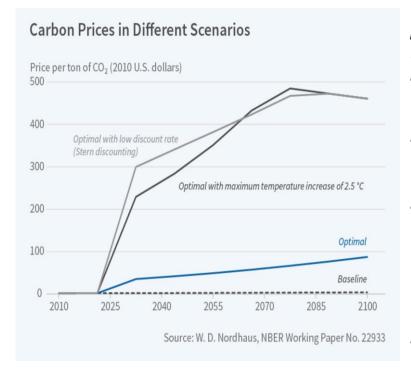
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Environmentalists (The Prophets) vs Economists (The Wizards)

"you could be 2% richer, but all you had to do was acidify the oceans and risk killing off coral reefs and other marine ecosystems, risk melting the ice caps with rapid sea-level rise...and so on, would you take all of that environmental risk, just to be 2% richer?"

-Ken Caldeira

- Measures to rapidly decrease emissions should be adopted to avoid reaching the "tipping point" after which no amount of measures can stop accelerated global warming.
- High "unrealistic cost" measures are necessary to avoid climate change doomsday.
- If drastic action is not taken now, global GDP losses will amount to 5% each year and damage estimates could rise to 20% of the GDP.
- Limit greenhouse gas emissions to 1% of global GDP each year.
- There should be absolute cuts in emissions, **60-80%** by 2050.
- A discount rate of 0% on carbon pricing should be adopted



"The danger with the very alarmist portraits—for which there is real basis—is that it will make people apathetic and hopeless"

-Paul Romer

- Romer believes that innovative economies will increase efficiency leading to lesser carbon emissions.
- Emissions should be taxed in a gradually increasing manner to encourage progress in a different vein. The development of energy efficient technology to avoid paying high taxes and continuing to earn profits.
- Limiting global warming to 1.5 degrees would cost the global economy more than \$50 trillion, while yielding benefits of well under \$5 trillion.
- Damages will account for 2.1% of global GDP at 3° and 8.5% of at 6°.
- According to Nordhaus's model, a 6° C rise would take 130 years with no action to mitigate climate change.
- A discount rate of 2-3% on carbon pricing should be adopted.

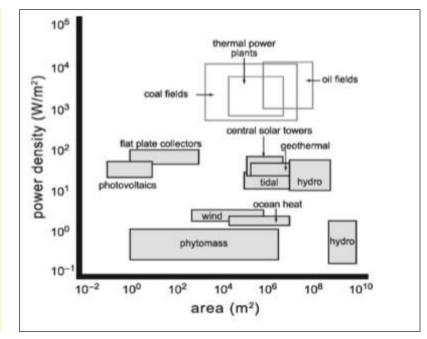
Independent View on Energy transitions – Vaclav Smil- The Turkey Fallacy?

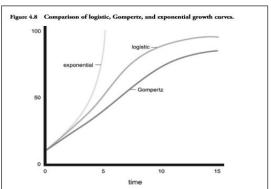
Findings

- Potential maximal usable renewable energy needs careful assessment of regional and local limits which makes it substantially low
- The renewable energies available for commercial harnessing fall short of today's fossil fuel flux
- Solar energy is the one kind of renewable energy which is large enough to satisfy global energy demand but the large scale commercial conversions of that flux is till in early stages
- Hydro projects are one of the stridently opposed form of renewable energy because of the negative impacts on the environment
- Transition to renewable energy will move the global energy system in the opposite and in a less desirable direction, away from the superior density fossil fuels

Challenges to the transition

- The overall scale of the coming shift on a global level
- Magnitude of renewable energy and their uneven distributions
- Unpredictability and uncertainty of most renewable energy flows
- Lower energy density of the fuels produced to replace solid and liquid fossil fuels
- Lower power densities with which we can harness renewable energy





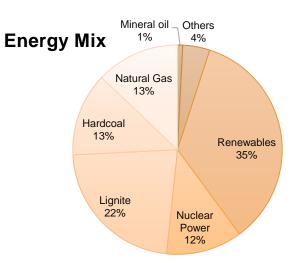
The windpower growth curves indicate how the growth pattern for renewable energy is ex post.

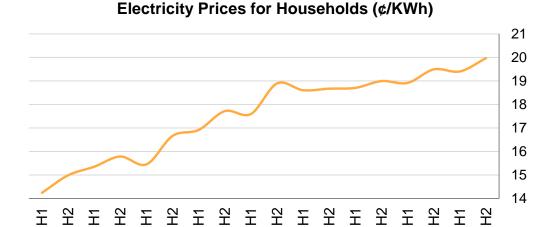
Source:- Energy Transitions: History, Requirements, Prospects: Vaclav Smil

Energy Transition Roadmap: Germany— The Prometheus

- GDP per capita: \$ 47,501.8
- Price of German electricity market rose by 53% to 49.53 \$/MWh in 2018.

Source: aleasoft, World Bank





2014 2015 2015 2016

- Lignite and hard coal capacity should fall to 15GW leading to a reduction of 5GW in lignite and 7.7GW in hard coal capacity.
- Overall reduction of a minimum of 12.5 GW of coal capacity.
- Switch from the current 2.3GW of grid reserve capacity from coal to gas.

A substantial interim step will take place to reduce 10 million tonnes of carbon emissions through an innovative project.

2012

2012 2013 2013

2025

2010

The German commission believe that coal-fired power generation should end completely by 2038.

2016

2018

Coal fired capacity should fall to a maximum of 9GW in lignite and 8GW in hard coal, leading to a reduction capacity of 10.9GW lignite and 14.7GW hard coal.

2022

Target of 40% emission reduction to be reached compared to 1990.

Stress in Power Sector

Source: Cleanenergywire

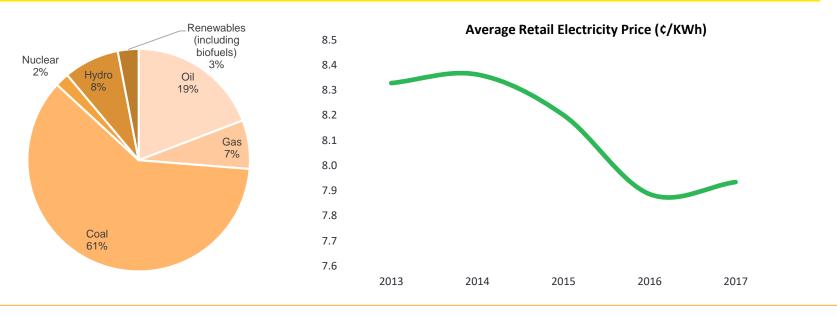
2038



Energy Transition Roadmap: China- The Hercules

GDP per capita: **\$ 7,755.0**

Source: World Bank



- Increase the share of renewables by 15%
- Increase renewable power capacity to 680GW
- Coal's energy share to reduce from 62% to 58%
- 270 million tonnes of coal capacity to be cut
- 14 large coal bases will account for 95% of coal production with an output of 3.7 billion tonnes

- China spent \$51 billion on power projects, 36% for coal projects and 11% for renewable projects
- China's emissions trading scheme launched to limit emissions and cover 1700 power companies

2020

Source: NDRC China, Sinopec report on transition, 2019, IEA, MDPI

 Lower carbon dioxide emissions per unit of GDP from 60% to 65% from the 2005 level.

2030

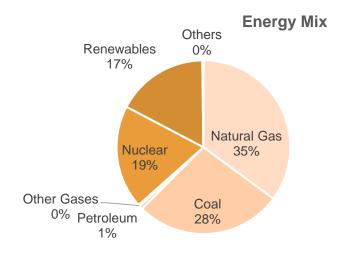
- It is estimated that coal power plant capacity will increase by 450 TWh
- Coal demand target to reduce to 3.5-4 billion tonnes

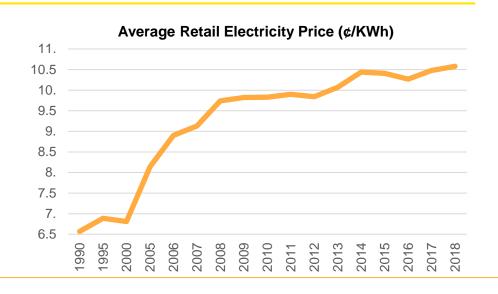


2017

Energy Transition Roadmap: USA- Random Walker

- GDP per capita: \$ 54,541.7
- The energy transition shown below was developed under the Obama administration. The trump administration moved to cut EPA's budget by 31%, cancel the clean action plan and remove the \$100 million allocated for research on combating climate change.





- coal power sector investments declined to only USD 48 billion
- average retail cost of new wind and solar PV energy in the United States has dropped to around 10 U.S. cents per kWh

- Half net oil imports
- 17% reduction in GHG emissions below 2005 levels
- integration of 50% variable distributed energy resources
- With electric vehicles and building energy management systems
- Reduce cost of transportation of fuel by more than 25% reaching the target of \$40/kilowatt

2017

2025

2013/14

Provide \$8 billion in loan guarantees to advance lower emission fossil energy technologies

Stress in Power Sector

2020

- \$500 billion savings through efficiency
- Reduction in GHG emissions by 500 million metric tons annually
- Cumulative savings exceeding 200 billion kWh

since 2009

Reduction in carbon

emissions by 3

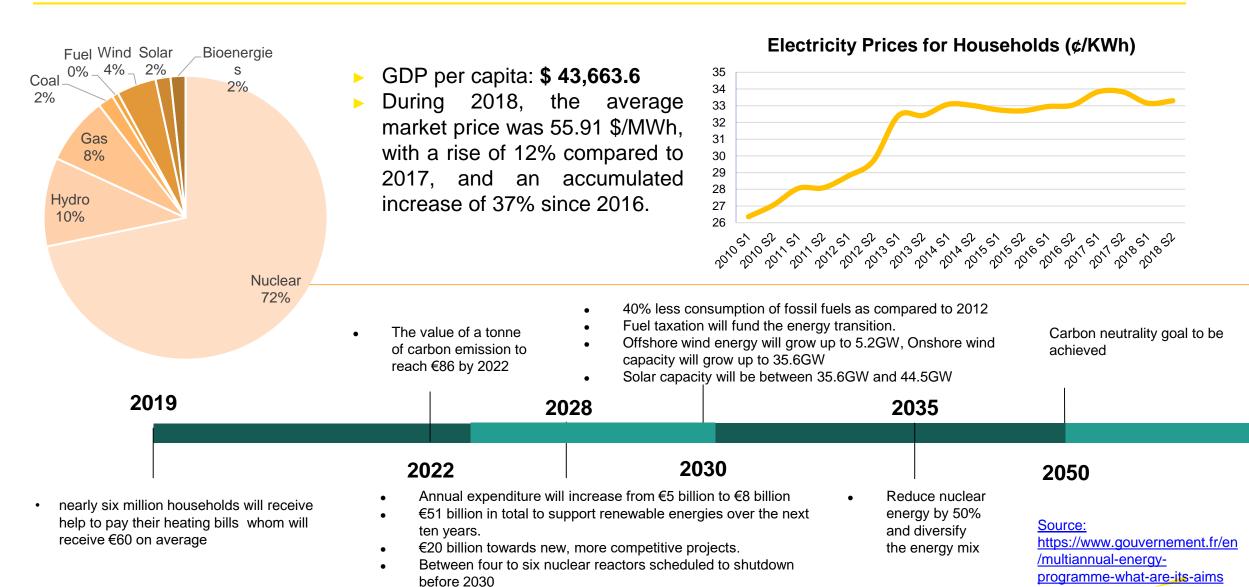
billion metric tons

2030

Source: EPA, US Dept. of Energy, World Bank Data, EIA, statista



Energy Transition Roadmap: France



Stress in Power Sector

India's preparedness for Energy Transition

Country	System Performance Rank	Economic Growth & Energy Sec Acces		Environemntal Sustainability
India	97	48%	71%	42%
Norway	1	89%	87%	70%
Sweden	2	74%	92%	78%
Switzerland	3	73%	87%	74%
France	4	70%	92%	69%
Uruguay	5	67%	81%	76%

Country	Transition Readiness	Capital & investment	Regulation & political commitment	and	Infrastructure and innovative business environment	Human capital and consumer participation	Energy system structure
India	76	50%	74%	46%	58%	36%	32%
Finland	1	76%	69%	82%	81%	83%	52%
Denmark	2	73%	68%	85%	78%	81%	49%
Austria	3	73%	67%	82%	75%	67%	60%
Switzerland	4	69%	75%	83%	83%	55%	58%
Sweden	5	62%	66%	84%	81%	62%	57%

Stress in Power Sector

Effective energy transition depends on the system performance of a country, which measures the ability of the energy architecture of the country to perform on:

- economic growth and development
- energy security and access
- environmental sustainability

Norway has the highest system performance rank.

The Energy Transition Index (ETI) captures the readiness of a country through six enabling dimensions:

- Energy system structure
- Regulation and political commitment
- iii. Capital and investment
- Human capital and consumer participation
- Infrastructure and innovative business environment
- Institutions and governance.

India

ETI Score: 51%

System Performance Score: 53%

Transition Readiness: 49%

Source: WEF, Energy Transition Index, 2019



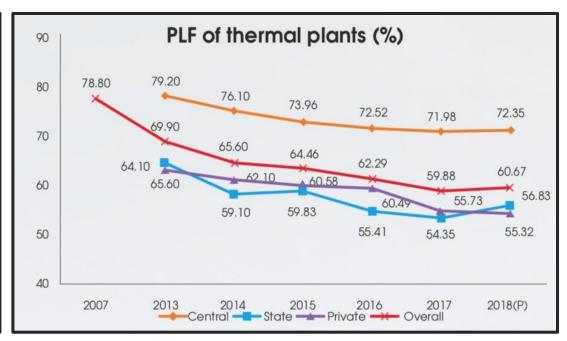


HLEC Report on Stressed Assets

Stressed Assets Overview

- Unreliable coal supply due to power plants without coal linkages from CIL
- Surplus supply and underutilization has led to high costs of power
- Slow project implementation by developers leading to cost overruns without sufficient financial capacity to service debt
- Non-compliance of banks and financial institutions on sanctioning additional term loans
- Unsustainable and aggressive tariff proposals by private sector developers have led to equity erosion and insufficient funds to service debt.
- Aggressive re-bid for coal mines have led to legal complications post-bidding
- Operational issues such as delays in land acquisition, statutory clearances, and inadequate transmission system have led to cost and time over-runs

Total No. of projects (Nos.)	34	
Total stressed capacity	40,130 MW	
Commissioned capacity	24,405 MW	
Under construction capacity	15,725 MW	
PPAs tied up	18,516 MW	
PPAs not tied	21,614 MW	
Linkages available	29,190 MW	
Linkage required	10,940 MW	
Resolved project's (08 nos.) capacity	8,820 MW	



0.7%

The peak energy demand in 2018, which has reduced from 8.71% in 2013

59.88%

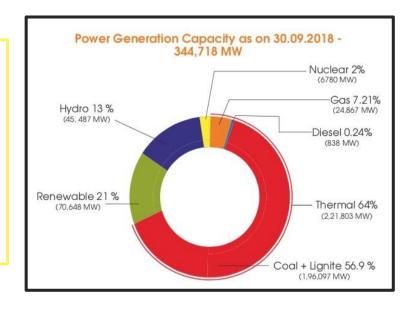
was the plant load factor in 2017-18, which declined from 78.8% in 2006-7.



HLEC Report on Stressed Assets

Current Situation in India

- ► The Electricity Act, 2003 removed licenses for power generation, introduced international competitive bidding, separated transmission from generation, and encouraged public and private sector participation.
- The increase in capacity and an addition of 99,209MW during the 12th five year plan period outpaced demand growth leading to a declining plant load factor
- 44% capacity addition, 77,891MW, from the private sector has led to a widening gap between demand and supply
- Per capita power consumption in India is 1122 units against the global per capita consumption of 3110 units



Recommendations

Coal Allocation

- Coal linkages to be allowed for short term PPAs and power to be sold in a day ahead market.
 Dold and ineff
- Generators can terminate PPAs in case of delayed payment from the DISCOM without the loss of coal linkages
- Stressed plants to use NTPC's PPAs until its own plants are commissioned
- 60% coal to be earmarked for e-auction
- Once a PPA has been bid for, a linkage should be assigned
- Coal shortages to be carried forward up till 3 months
- States can reassign coal linkages according to plant efficiency

Sale of Power , Regulatory & DISCOM payment issues

- Old and inefficient plants not complying with environmental regulations to be phased out without a demand/supply mismatch
- Late payment surcharge to be mandatory without negotiation
- Tri-partite agreement to be set up with the RBI to enable stressed assets to obtain loans from public financial institutions

Other Recommendations

- Approvals should not be cancelled even if a power plant is being acquired by another entity
- In case there is a delay in the commissioning of the plant, PPAs should not be cancelled but kept on hold for a period of time
- Ministry of power and ministry of petroleum and natural gas to devise a scheme in line with the e-bid RLNG scheme to revive gas power plants



Suggestions – Distribution companies



- Regulated supply only for small consumers (Moving away from the cross subsidy model)
- No new long-term, baseload power purchase by DISCOMs without rigorous demand assessment
- Meeting the challenge of agricultural demand through solar feeders
- Re-thinking tariff design in the context of changing cross-subsidy scenario
 - Moving away from cost-plus regulation
 - Inflation-indexed tariff increase
 - Equitable tariff design for small consumers

Developing robust markets

- Due to variability in supply and demand, distribution companies should not procuring power on round the clock (RTC) basis, especially in the short term
- More flexible instruments to aid procurement decisions and development of capacity markets

Accountability for supply and service quality

- Monitoring actual supply hours
- Metering and billing
- Public hearings on supply and service quality issues
- Harnessing technology to improve efficiency

	Slab for monthly consumpti on (kWh)	Average tariff (Rs/kWh) in a typical tariff design			Average tariff (Rs/kWh) under the proposed LT general category		
		Domestic	Commercial	Industrial	Domestic	Commercial	Industrial
,	0-100	3.5		8.5	3.5	3.5	3.5
	101-200	4.5			4.5	4.5	4.5
	201-300	5.5			5.5	5.5	5.5
	300-500	6.5			7	7	7
	>500	7			9	9.5	8.5



Suggestions – Distribution companies (Schemes)

Integrated Power Development Scheme (IPDS)

Approved on 20.11.2014. with a total outlay of Rs 32,612 crore which includes a budgetary support of Rs25,354 crore from Govt. of India. The objectives of scheme are:

- Strengthening of sub-transmission and distribution networks in the urban areas;
- Metering of distribution transformers / feeders / consumers in the urban area.
- IT enablement of distribution sector and strengthening of distribution network

Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY)

Scheme approved on 20.11.2014 with a total outlay of Rs 44,033 crore which includes a budgetary support of Rs 33,453 crore from Govt. of India. The objectives of scheme are:

- Separation of agriculture and non-agriculture feeders
- Strengthening of sub-transmission and distribution networks in the rural areas:
- Metering of distribution transformers / feeders / consumers in the rural area.
- Rural Electrification

National Electricity Fund (NEF)

- To promote investment in the distribution sector
- Provide interest subsidy on loans disbursed to the Distribution Companies (DISCOMS) both in public and private sector, to improve the distribution network for areas not covered by RGGVY and R-APDRP project areas.
- The preconditions for eligibility are linked to certain reform measures taken by the States and the amount of interest subsidy is linked to the progress achieved in reforms linked parameters

Ujjwal DISCOM Assurance Yojana

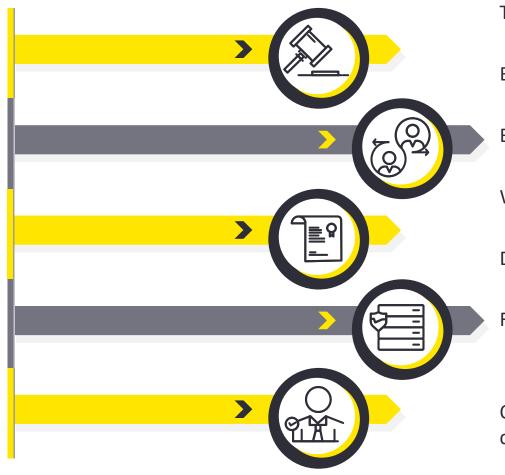
- (UDAY) is the financial turnaround and revival package for electricity distribution companies of India (DISCOMs) initiated by the Government of India with the intent to find a permanent solution to the financial situation of power distribution.
- Allows state governments, which own the DISCOMs, to take over 75 percent of their debt as of September 30, 2015, and pay back lenders by selling bonds. DISCOMs are expected to issue bonds for the remaining 25 percent of their debt.

Strategy





Solutions



Tone down expectations and be realistic about time frames

Better design of PPPs

Better data with less lag- Metering

Wholesale market reforms

Do away with long term contracts

Find alternate financing mechanisms than sourcing finance from banks

Balance Sheet Financing vs Special Purpose Vehicle

Optimal level of creative destruction- Renewable energy penetration continues to increase



The views and opinions expressed in this presentation are personal views and do not represent views of any entity whatsoever with which I have been, am now, or will be affiliated

