

THE STRUCTURAL ANALYSIS OF THE RENEWABLE ELECTRICITY SECTOR IN INDIA USING INSTITUTIONAL ANALYSIS AND DEVELOPMENT (IAD) FRAMEWORK.

Redefining Diversity and Dynamism of Natural Resource Management in Asia July 13 - July 16, 2018

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- The investment decision situation in the renewable electricity sector is broken into its elements using the Institutional Analysis and Development framework. The elements are identified and the key actors, the investors are approached for a survey. The survey has helped to identify the main detractors and the main promoting measures for renewable energy.

Introduction

- Energy is a key input towards raising the standard of living and income .
- There exists positive correlation between per capita electricity (a proxy for all energy forms) consumption and Human Development Index (HDI).
- Nearly 304 million Indians live without access to electricity, and about 500 million people, still dependent on solid biomass for cooking.

The Current Energy Scenario

- India Currently has an installed capacity of **3,43,899** MW of power generation as on 31 March 2018.
- According to the Central Electricity Authority, the coal fired power plants have the largest contribution to the sector with 1,96,958 MW of installed capacity.
- The other fossil fuels which contribute to India's power generation are gas with an installed capacity of 24,897 MW and diesel having an installed capacity of 838 MW.
- The installed capacity of nuclear power plants is 6780 MW, hydro 45,403 MW and
- Renewable energy 69,022 MW.
 - Source: Ministry of Power, Government of India
(<https://powermin.nic.in/en/content/power-sector-glance-all-india>)

Future Energy Objectives

- The National Energy Policy of India, 2017 proposes to achieve 100 per cent electrification of all census villages by 2018 and universal electrification with 24 x 7 electricity by 2022. The Policy states that the primary objective is to banish energy poverty in India by making access to energy at affordable prices to the whole population of India.
- The other objectives of the policy are to achieve energy security, sustainability and economic growth through planning the energy future of India. Since all the energy forecasts suggest a huge surge in energy demand, the government of India shall plan its policy measures carefully to meet the future requirements. In addition to meet the energy demand, the government is also responsible to create demand for energy from the rural poor who have no access to clean energy.

The Competing and Conflicting Problems

- Energy Demand & Economic Development

Table 1: Actual energy consumption in 2012 and projected consumption under alternative scenarios in major sectors in 2022 and 2040

Sectors	2012	2022		2040	
TWh		BAU	Ambitious	BAU	Ambitious
Buildings	238	568	525	1769	1460
Industry	2367	4010	3600	8764	7266
Transport	929	1736	1628	3828	3243
Pumps& Tractors	237	423	388	728	592
Telecom	83	131	124	207	164
Cooking	1072	829	684	524	467
Total	4926	7697	6949	15820	13192
% reduction in energy demand in 2040	17%				

Table 1

- Source: The Proposed National Energy Policy, 2017, NITI Aayog

The Competing and Conflicting Problems

- Addressing Energy Poverty
- Access to energy data for Census 2011 shows primary energy sources for lighting in 2011 as 55.3 per cent rural, 92.7 per cent urban and 67.2 per cent overall.

Household Access (%)

Energy Source	61st Round 2004-05			66th Round 2009-10		
	Rural	Urban	Total	Rural	Urban	Total
Electricity	54.9	92.3	65.2	67.3	93.9	75.5
LPG	8.6	57.1	21.9	15.5	66.2	31.2

Source: Planning Commission of India. (2013). Twelfth Five Year Plan (2012–2017), Vol. I p132

Meeting the Energy Demand

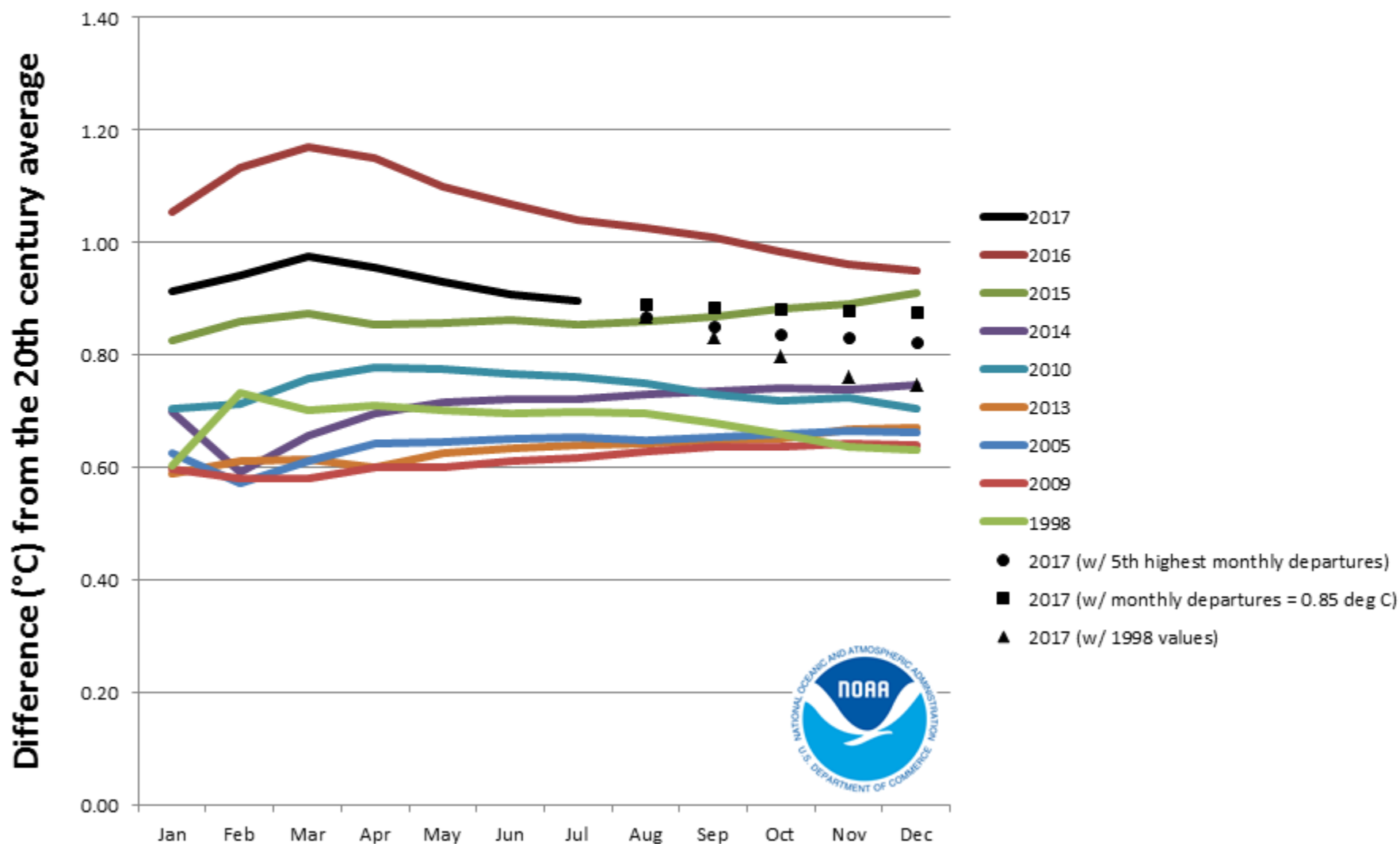
NEP: Version as on 27.06.2017

Primary Energy Supply:

TWh	2012	2022		2040	
		BAU	Ambitious	BAU	Ambitious
Renewable & Clean Energy	266	797	823	2010	2602
Coal	3281	6021	5529	11320	8433
Oil	1936	3024	2762	6036	4883
Gas	570	1018	1016	1762	1788
Others	1060	1108	1152	1351	1626
Total	7113	11968	11282	22479	19332

Year-to-Date Global Temperatures

for 2017 and the other eight warmest years on record



Selected Significant Climate Anomalies and Events

July 2017

GLOBAL AVERAGE TEMPERATURE

July 2017 average global land and ocean temperature was the second highest for July since records began in 1880.

NORTH AMERICA

Warmer- to much-warmer-than-average conditions were present across much of North America, tying with 2016 as the fifth highest July temperature since continental records began in 1910.

ARCTIC SEA ICE EXTENT

July 2017 sea ice extent was 16.1 percent below the 1981–2010 average—the fifth smallest July sea ice extent since satellite records began in 1979.

ASIA

Near- to -cooler-than-average conditions were observed across much of northern Asia, while the majority of the southern half of Asia had much-warmer-than-average conditions, with several locations across Mongolia and China having record warm July temperatures. Overall, Asia had its fifth highest July temperature in its 108-year record.

KINGDOM OF BAHRAIN

The Kingdom of Bahrain, as a whole, had its highest July mean and maximum temperature on record. The nation's July minimum temperature was the third highest on record.

EUROPE

Europe had near to warmer-than-average conditions during July 2017, resulting in the coolest July temperature since 2011 and the 17th highest on record.

CONTIGUOUS UNITED STATES

Nearly 12% of the contiguous U.S. was in drought by the end of July. Drought intensified across the Northwest, Northern Rockies and Central to Northern Plains.

SOUTH AMERICA

July 2017 ranked as the seventh highest July temperature in the 108-year record.

AFRICA

Much-warmer-than-average temperatures engulfed much of Africa during July 2017, with several locations in the southern half of Africa experiencing record warmth. Overall, this was Africa's highest July temperature on record.

ISLAND OF FIJI

Below to much-below-average conditions affected much of Fiji during July 2017.

AUSTRALIA

Drier and warmer-than-average conditions were present across much of Australia during July 2017. The national average temperature was the highest since 1975 and the third highest in the nation's 108-year record.

ANTARCTIC SEA ICE EXTENT

July 2017 sea ice extent was 4.5 percent below the 1981–2010 average—the smallest July sea ice extent on record.

NEW ZEALAND

Wetter-than-average conditions were present across New Zealand, with several locations recording more than double their monthly precipitation totals.

Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <http://www.ncdc.noaa.gov/sotc>



2.0

Source: NASA - GISTemp LOTI v3

Current 12m avg	1.177C
Degrees below 2°C	0.823C

Anomaly from preindustrial (degrees C)

1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0

1880 1900 1920 1940 1960 1980 2000 2020 2040

Baseline period 1880-1909

— 12 month running avg

— 30 year linear trend

◆ Monthly data

CO2 404.02 ppm

Current 30y trend 0.167 C/decade

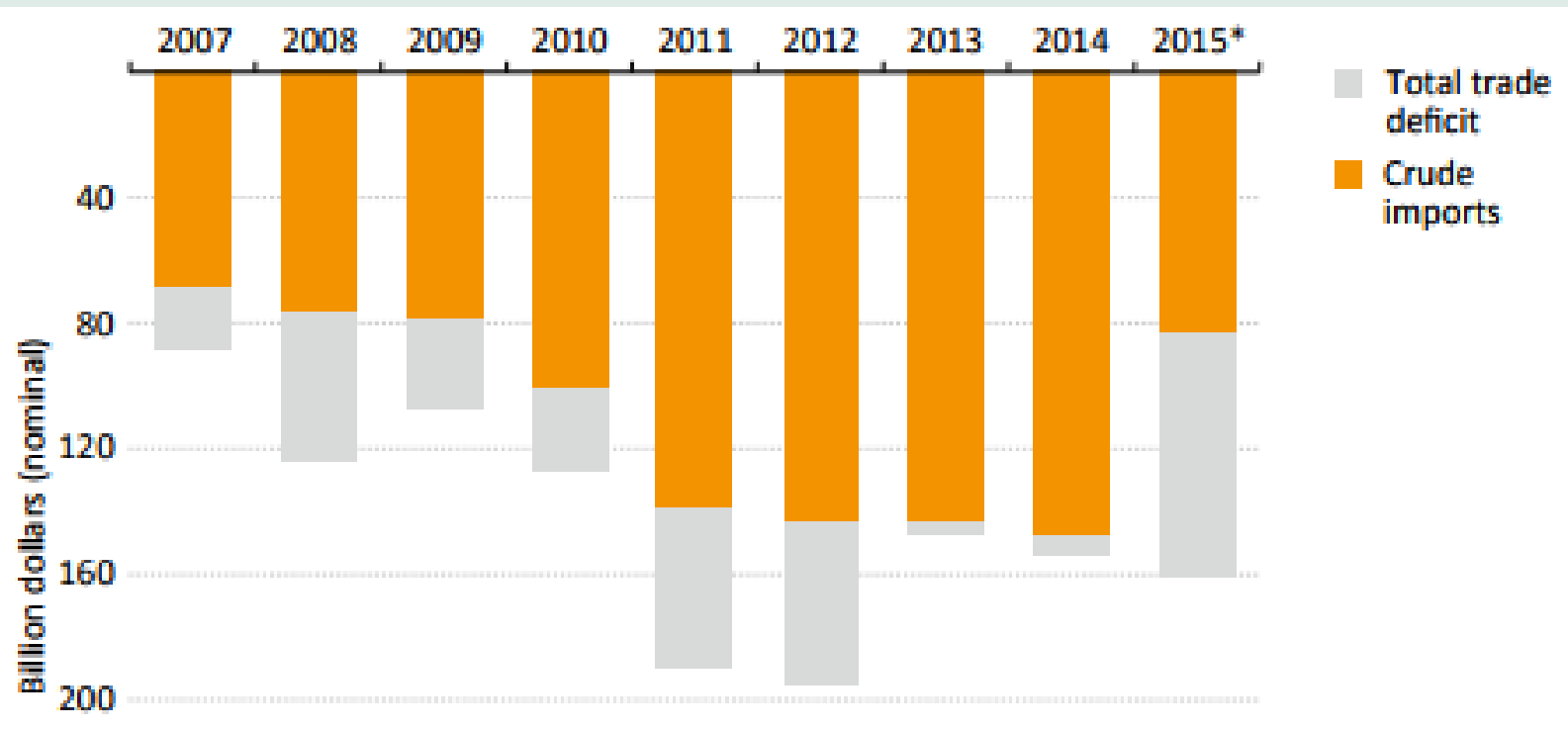
<http://skepticalscience.com/2c-2016-02>

The Competing and Conflicting Problems

- According to the latest BP Statistical Review of World Energy total global reserves, by fossil fuel, are now:
 - Coal - 1,139 billion tonnes
 - Natural Gas - 187 trillion cubic meters
 - Crude Oil - 1,707 billion barrels
- While these volumes may seem large at a glance, at today's level of extraction and production rates, BP's estimated proved reserves, by fossil fuel, would be exhausted as follows:
 - Coal - year 2169
 - Natural Gas - year 2068
 - Crude Oil - year 2066
 - Source: BP Energy Outlook 2035

The Competing and Conflicting Problems

Figure 2.5 ▷ Crude oil imports as a share of the trade deficit



* Estimate.

Sources: Ministry of Petroleum and Natural Gas (2014); IEA analysis.

Table 8.1 : Wholesale Price Indices of Energy Commodities in India

(2004-05=100)

Year	Petroleum Products								Coking Coal	Coke	Lignite	Electricity
	Petrol	Kero-sene	Aviation Turbine Fuel	High Speed Diesel Oil	Light Diesel Oil	Furnace Oil	Lubri-cants	Liquified Petroleum Gas				
1	2	3	4	5	6	7	8	9	10	11	12	13
2005-06	113.6	99.9	132.0	119.7	123.4	131.2	101.9	106.1	106.7	152.7	85.7	102.6
2006-07	125.3	99.9	151.6	130.2	143.8	148.4	131.8	106.1	106.7	152.7	88.5	105.3
2007-08	119.1	99.9	157.4	125.6	162.3	166.0	145.8	106.1	111.4	155.4	99.1	106.2
2008-09	128.3	99.9	194.5	135.8	178.3	197.9	171.1	117.2	119.0	234.4	140.0	106.4
2009-10	119.3	99.9	137.0	133.0	161.5	187.6	174.5	111.9	126.3	234.4	134.9	107.4
2010-11	143.0	127.2	164.9	151.7	192.5	223.7	192.6	125.9	139.2	233.1	144.1	113.2
2011-12	174.4	154.4	229.4	164.5	252.0	304.6	230.4	143.2	177.1	219.3	172.6	115.0
2012-13	186.3	162.9	257.9	183.6	275.7	337.8	244.6	158.5	173.4	219.3	187.0	129.8
2013-14	192.6	166.5	274.0	217.8	302.5	351.1	259.5	168.0	181.3	219.3	189.7	158.7
2014-15	182.1	155.2	241.0	223.3	262.0	299.1	271.8	169.1	172.0	219.3	191.3	168.0
2015-16	163.5	145.4	158.5	186.9	172.0	176.3	277.5	162.1	172.0	219.3	193.3	174.3
Increase in 2015-16 over 2014-15 (%)	-10.25	-6.27	-34.22	-16.28	-34.36	-41.05	2.11	-4.10	0.00	0.00	1.05	3.74

Source :Office of the Economic Advisor, Ministry of Commerce & Industry.

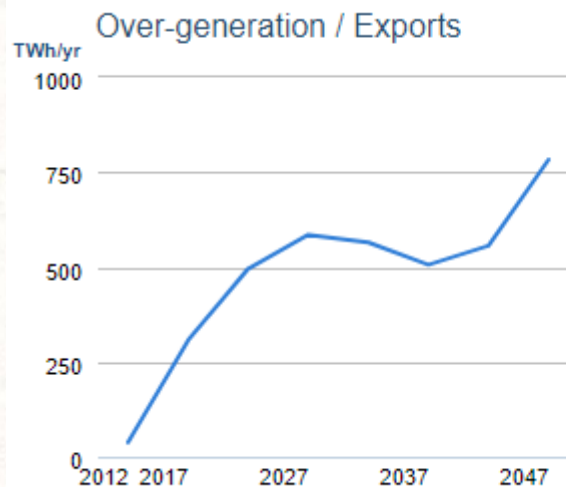
The Competing and Conflicting Problems

- Economic Development
- Energy Poverty
- Global Warming
- Depleting Fossil Fuels
- Trade deficit
- Affordability
- Availability
- Accessibility
- Accountability

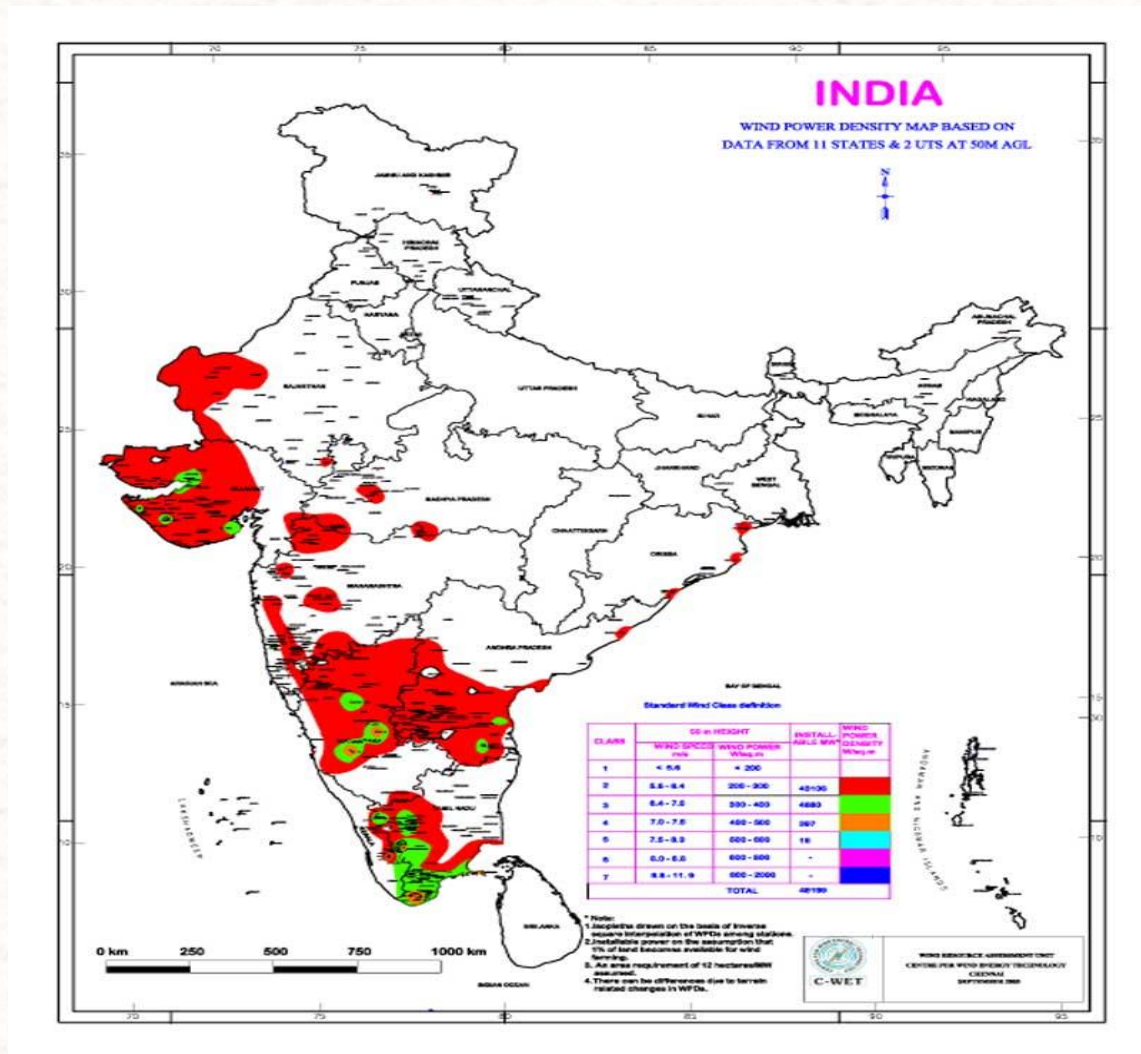
How these problems are competing and conflicting with each other?

Supply - Renewable and Clean Energy

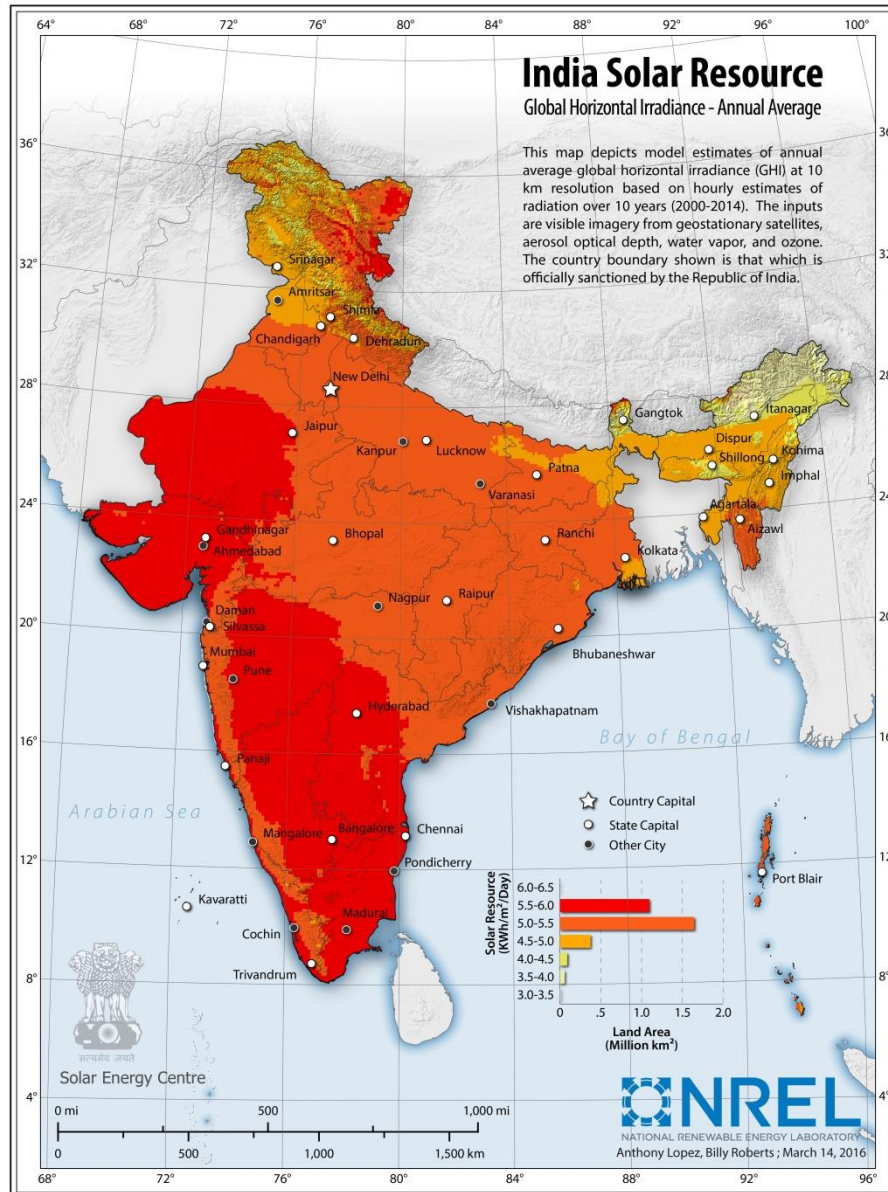
Solar	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	✓
Wind	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✓
Nuclear	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✓
Hydroelectricity	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✓
Bioenergy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✓
Waste to Energy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✓
Hydrogen	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	✓



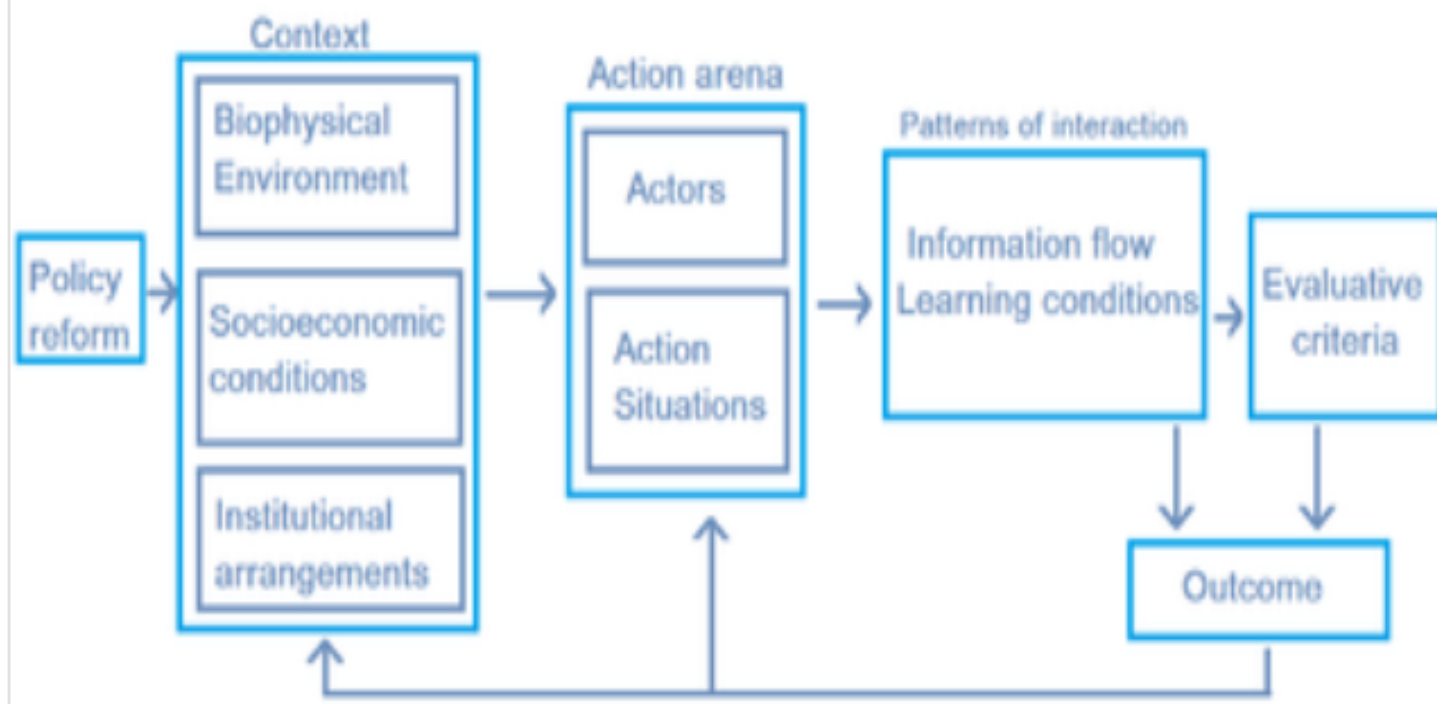
This scenario is over generating **783 TWh** of electricity in 2047. You may want to dial back your supply options for minimizing this value



- Source: <http://www.inwea.org/imgs/wpd.jpg>



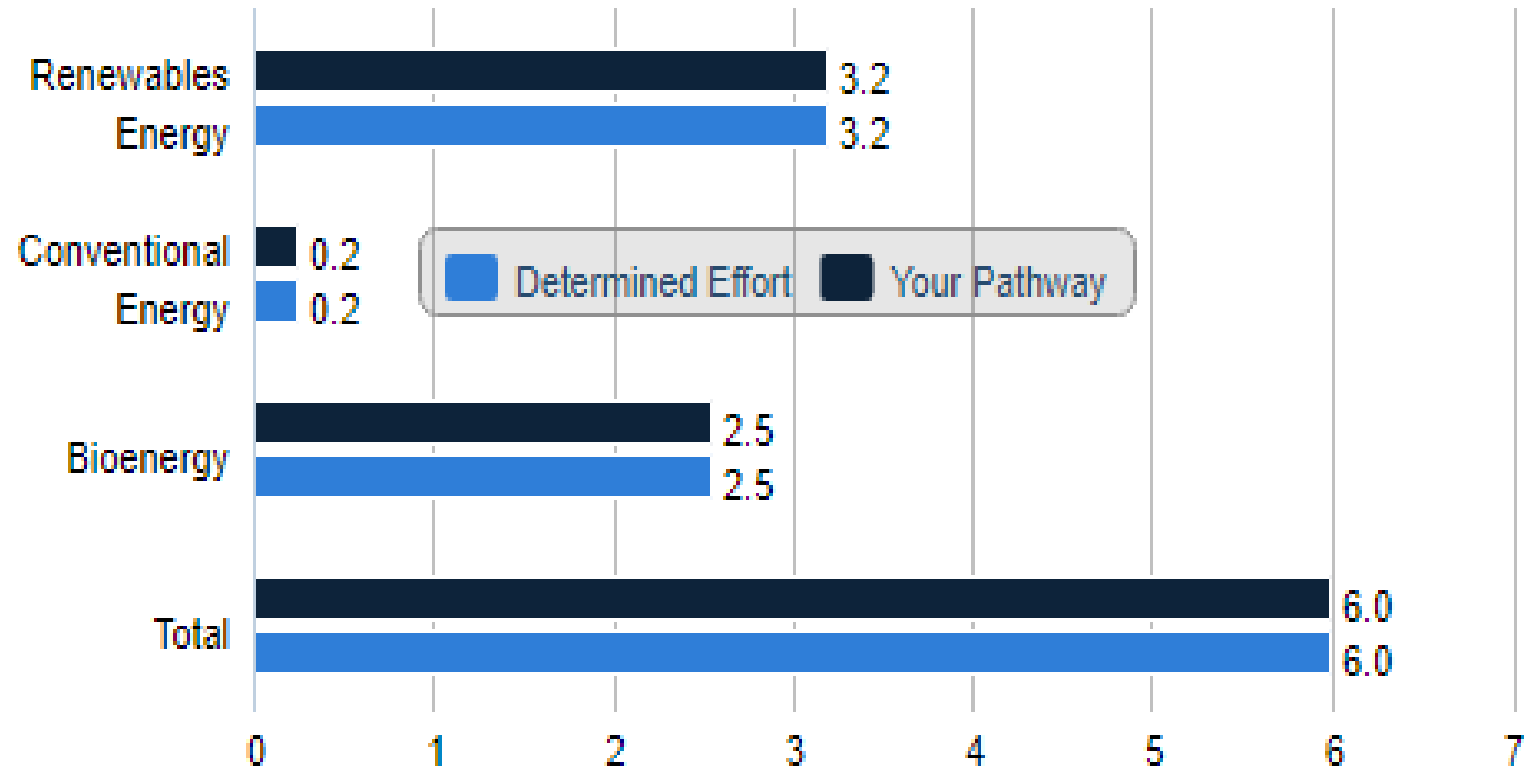
The Institutional analysis and development framework

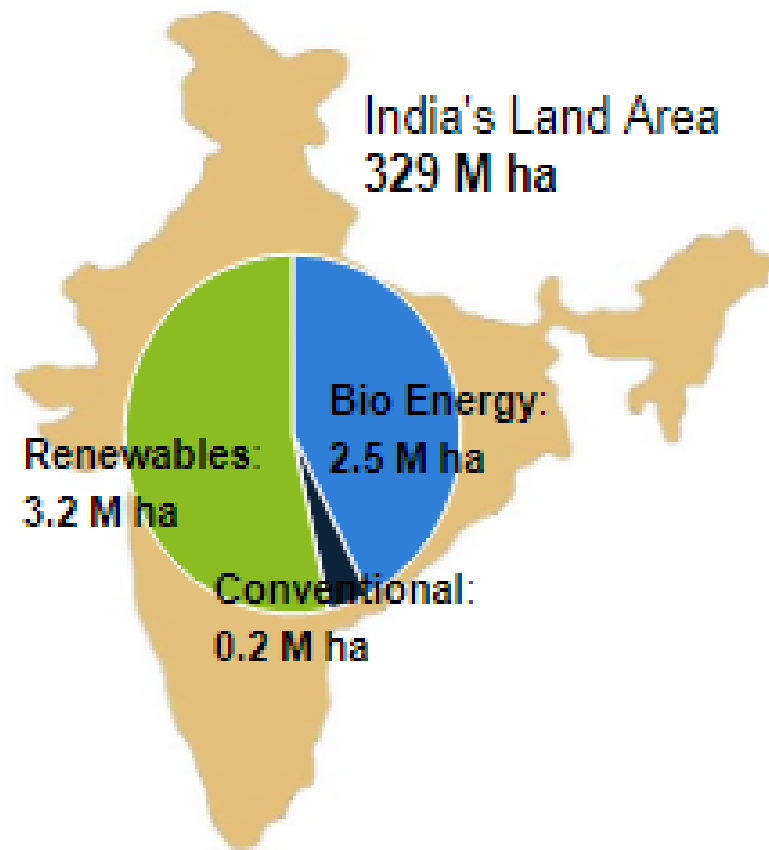


IAD framework diagram

Land Footprint (2047)

In Million hectares of land





Percent Share of Land Requirement (2047)

Renewables	0.97%
Conventional	0.07%
Bio Energy	0.77%
Total	1.82%

- Total Land Required- 5.9 M Ha = 59,000 Sq Km
- Area of the State of Uttarakhand- 53,483 Sq Km

The Regulatory Mechanism

The regulatory mechanism for electricity exists both at the central as well as the state level. The authorities forming part of this structure consist of the following:

- 1. Ministry of Power
- 2. Statutory Bodies
 - a) Central Electricity Authority
 - b) The State Electricity Boards
 - c) Central Electricity Regulatory Commission
 - d) Electricity Regulatory Commissions of the State,
 - e) Public Sector Electric Companies, as Generating Companies, Transmission Utilities and Licensee.
- 3 Appellate Tribunal For Electricity

- 1. The National Thermal Power Corporation (NTPC)
- 2. The National Hydroelectric Power Corporation (NHPC)
- 3. The North Eastern Electric Power Corporation (NEEPCO)
- 4. Power Grid Corporation of India Ltd. (POWERGRID)

Electricity Act 2003

- Provisions affecting Renewable Energy (RE)
- *National Electricity Policy and Tariff Policy, Sections 3(1)*
- Under Sections 3(1) it has been stated that the Central Government shall, from time to time, prepare and publish the National Electricity Policy and Tariff Policy, in consultation with the state governments and authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or material, hydro and renewable sources of energy.

- *National Policy for Stand-alone Systems, Section 4*
- Section 4 states that the Central Government shall, after consultation with the state governments, prepare and notify a national policy, permitting stand-alone systems (including those based on renewable sources of energy and other non-conventional sources of energy) for rural areas.

- *Promotion of cogeneration and generation of electricity from renewable sources of energy Sections 61, 61(h) and 61(i)*
- Sections 61, 61(h) and 61(i) state that the appropriate commission shall, subject to the provision of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely, the promotion of cogeneration and generation of electricity from renewable sources of energy; and the National Electricity Policy and Tariff Policy.

- *Renewable Energy Purchase Obligations Section 86(1)(e)*
- Section 86(1) and 86(1)(e) state that the state commissions shall discharge the following functions, namely, promote cogeneration and generation of electricity from renewable sources of energy by providing, suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution license.

CENTRAL GOVERNMENT POLICY FRAMEWORK FOR RENEWABLE ENERGY

- **Ujwal Bharat**
- Ujwal Bharat is a scheme first put forth in May of 2016. It includes power sector reform and general goals of lighting up or electrifying India's traditionally stranded and disconnected places.
- It's main mission underscores:
 - 24 x 7 affordable environmental friendly power for all by 2019
 - connecting the unconnected
 - 24 x 7 power for all
 - affordable
 - environment friendly

- Company Law and SEBI Regulations on raising capital
- FEMA regulations
- Restrictions on Land Acquisition

- *Institutional barriers*
 - Inter-institutional coordination Lack of coordination and cooperation within and between various ministries, agencies, institutes and other stakeholders delays and restricts the progress in RE development.
- *Lack of Single window clearance system*
- *Fiscal and financial barriers*
 - Budgetary constraints
 - Lack of Financing of RE projects
- *Market-related barriers*
 - Level playing field for RE
 - Inadequate market prices

- *Transmission network*
- *High equipment costs*
- *Inputs for RE plants*
- *Absence of serious developers for SHP*

- **Technological barriers**
 - *Technology risk*
 - *Absence of minimum standards*
 - *R&D and manufacturing capabilities*
- **Information barriers**
 - *Lack of skilled manpower*
 - *Lack of information and awareness*
- **SEBI Crowd Funding Regulations**

It is an unsolved problem

- Energy Policy 2017
- The future energy technology.

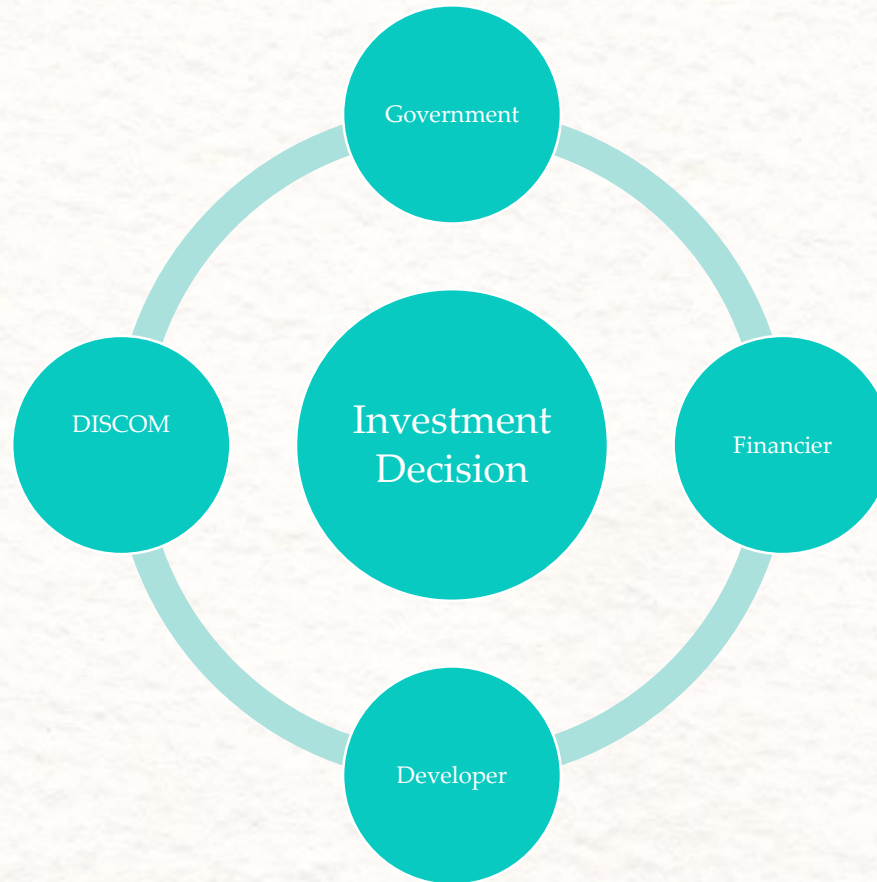
Sustainable Energy: Definition

- *“Sustainable energy is the renewable energy which can be created in abundance and is safe, secure, efficient, affordable, reliable and environmentally-sensitive.”*
 - Nuclear Energy meets most of them.
- A ‘*Sustainable Energy System*’ is where the sustainable energy is produced and consumed efficiently.
 - Surendran, Sujith Painadiyil and Ahmad, Tabrez, The Need for a Legal Definition of ‘Sustainable Energy’ for a Sustainable Future (October 15, 2016). Sujith Surendran & Dr. Tabrez Ahmad, The Need for a Legal Definition of “Sustainable Energy” for a Sustainable Future, 2 Energy Law Reports 95–105 (2016). Available at SSRN: <https://ssrn.com/abstract=2852926>

How to address the situation?

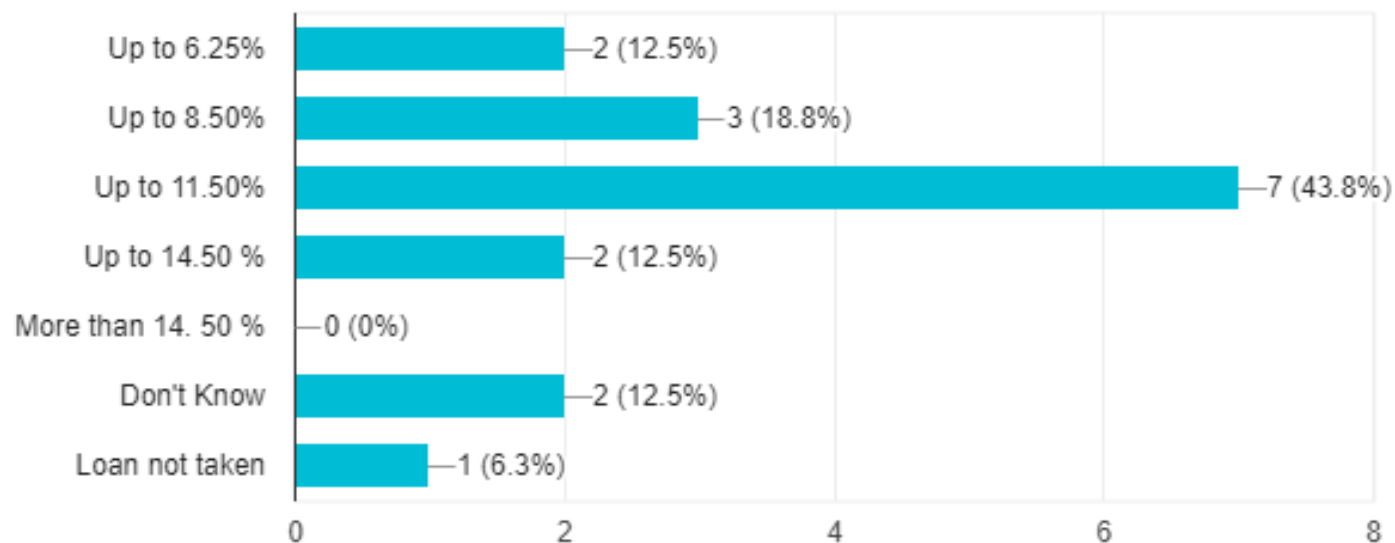
- By making more investments in the sector.
- Government resources are limited
- Increased private investments required
- How to improve private investments?
 - Understanding the action situation- ie., Decision to invest
 - The factors influencing the decision
 - Actors and their positions
 - Influence of actors and positions in the situation

Action Scenario



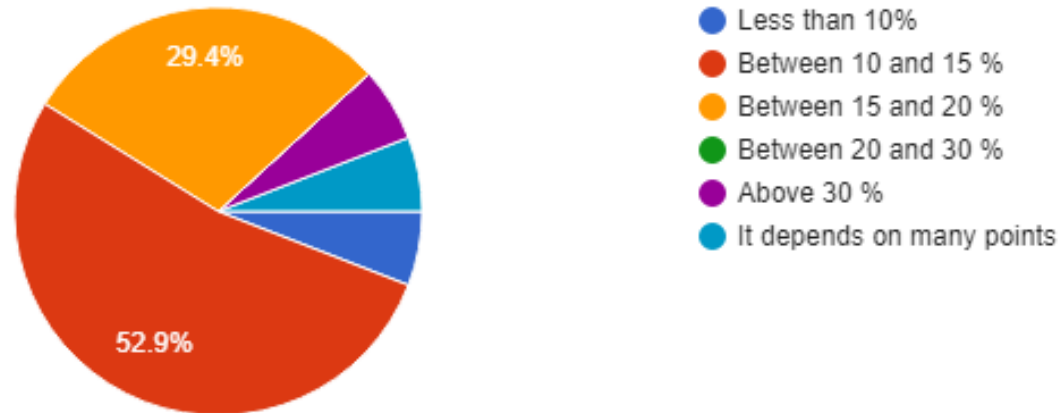
What are the interest rates at which credit is provided to a developer of a Solar Plant?

16 responses



What is the current rate of return on investment?

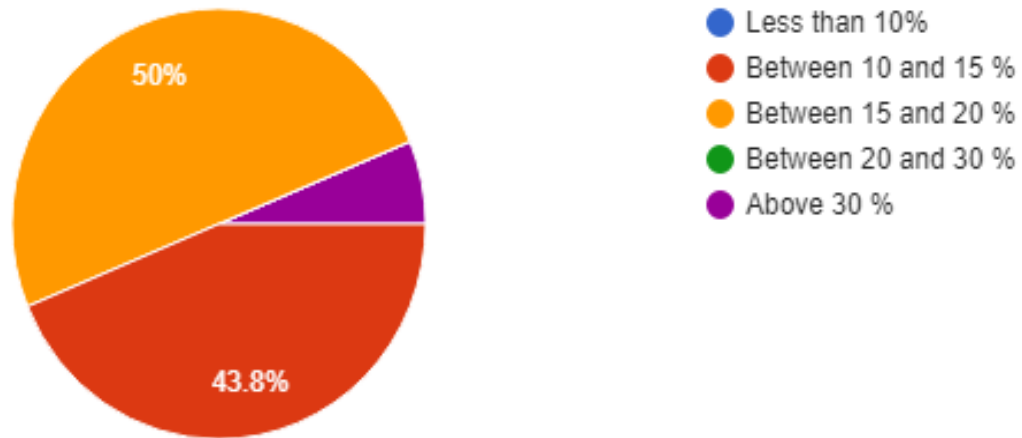
17 responses



- An Average 15% return on investment.

What is the expected return on investment?

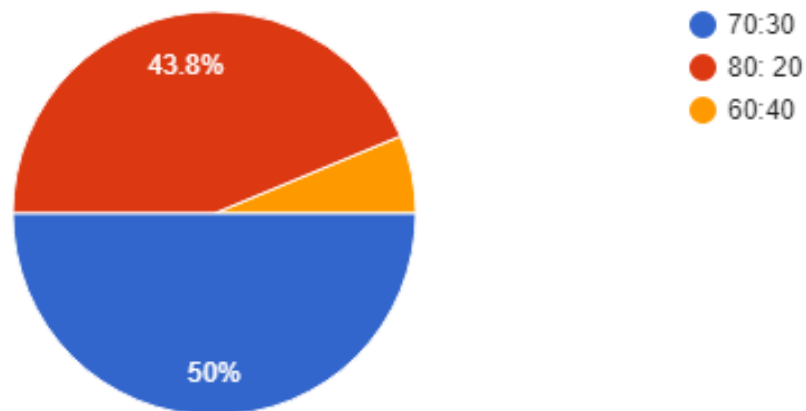
16 responses



- Average 15%

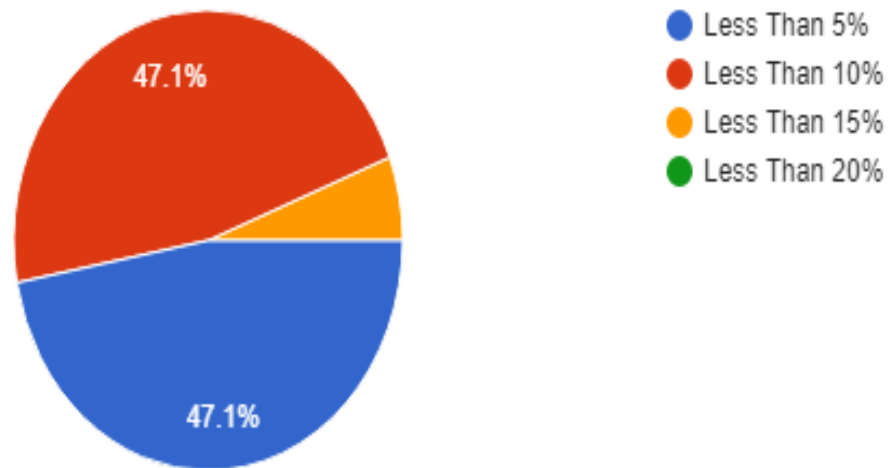
What is the preferred debt equity ratio

16 responses



Please suggest an ideal interest rate for debt capital

17 responses



- High interest rates on debt capital
 - Remote areas
 - Lack of service provision by banks
 - Lack of proper title on the property
 - Lack of asset base to offer as security
 - Lack of government policy directive

Conclusion

- Policy intervention required to create a robust investment environment
- Interest rates shall be reduced
- Separate priority sector target
- Robust system of market-financial instrument-securitization.