Unpacking India's Energy and Carbon Future

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CENTRE FOR POLICY RESEARCH

Outline

- Landscape of energy and climate change debates in India
- India's carbon emissions projections
- India's energy projections
  - Supply; Electricity; Demand
- Energy demand: Bottom-up
  - Residential electricity use and the case of the National Capital Region
- Conclusions

India as an emerging economy

	GDP-PPP (current International $) 2014 $ billion	Total GHG Emissions (Mt CO_2) – 2016
US	17,419	2
EU (28)	18,645	
China	18,017	1
Russia	3,745	4
Germany	3,704	6
India	7,384	3
Brazil	3,263	12
South Africa	704	13
Bangladesh	496	

Source: World Bank; Global carbon atlas

India as a premature power

	GDP-PPP per capita, (current international $) 2014	GHG Emissions per capita (including LUCF) in 2012 - tCO_2e	Multidimensional Poverty Index rank
US	54,629	19	NA
EU (28)	36,326	8	NA
China	13,206	8	5
Russia	25,636	16	NA
Germany	45,802	10	NA
India	5,701	2	55
Brazil	15,838	9	3
South Africa	13,046	9	10
Bangladesh	3,123	1	50

Source: World Bank; WRI CAIT; UNDP Human Development Report 2015.

India's energy and climate context

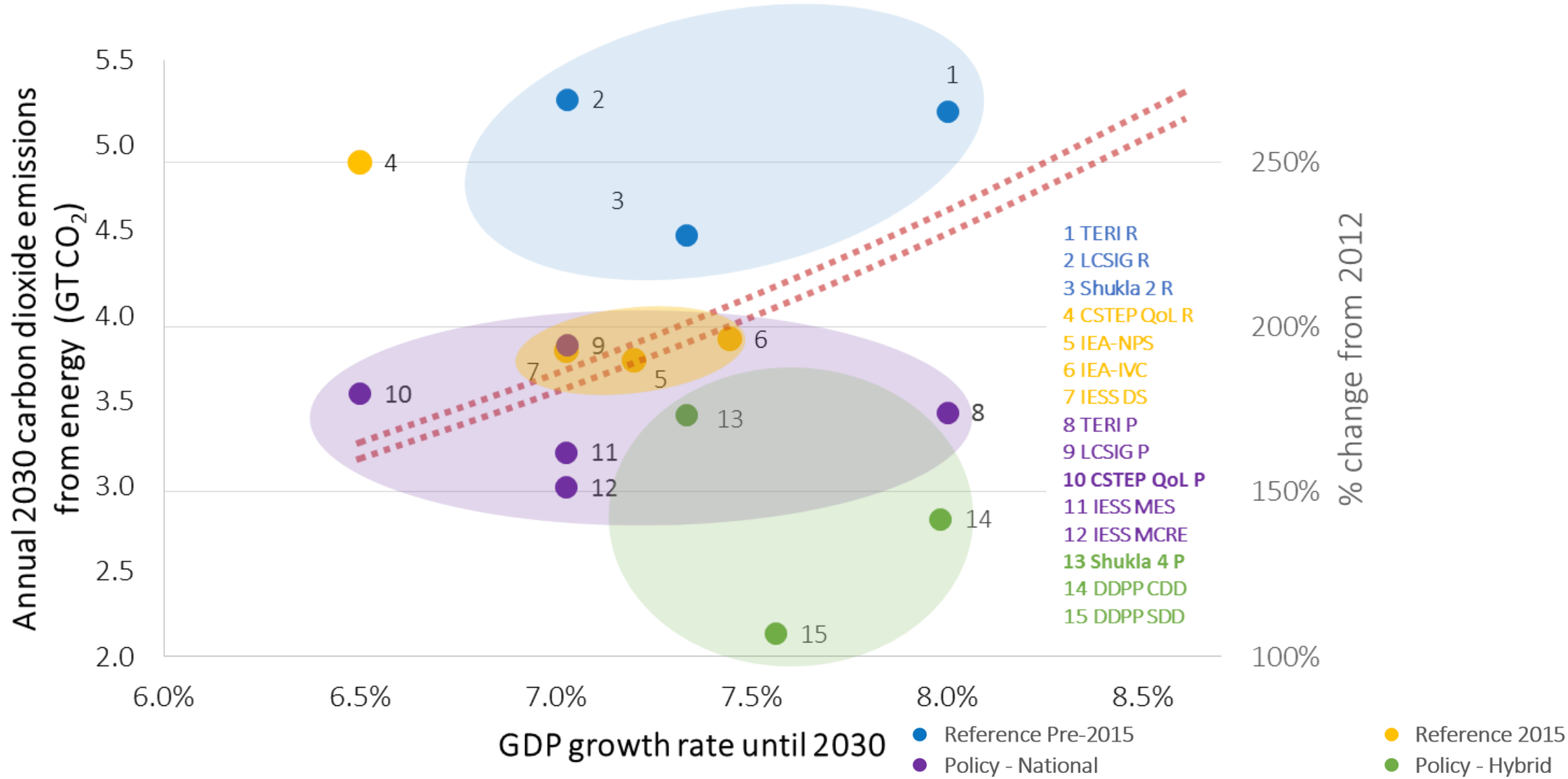
- Inter-related challenges:
  - Significant emitter of GHG emissions
  - Starting from a low base of development with high vulnerability to climate change impacts
- Indian actions central to shaping global climate future
  - But do they make India a 'villain' or 'hero'?
  - Shifting global perceptions: From a focus on jeopardizing the climate to a forerunner of low-carbon actions
- Are these perceptions rooted in facts and analysis? What can we credibly say about India's energy and climate future?

India's impending transitions

- Uncertainties posed by the pace, scale and scope of transitions
  - Urbanisation: Urban population to double between 2014 and 2050
  - Infrastructure: Two-thirds of building stock in 2030 yet to be built
  - Jobs: 10 m people to enter the job market annually in next two decades
  - Access: 800 m lack clean cooking fuel, 300 m lack access to electricity

- Methodological and conceptual challenge of estimating trajectories
- Subsequent method: Synthesize results across (15) recent model scenarios of India's short and medium term energy future

Annual CO_2 emissions from energy (2030 projections)



Dubash, Khosla, Rao & Bhardwaj "Analysis to Inform Nationally Determined Climate Contributions: Lessons from India" *Under review.* (2017)

Annual CO_2 emissions from energy (2030 projections)

- Wide range of 2030 projections
  - Range of projected emissions of same order of magnitude as current emissions
- Compare pre 2015—post 2015 reference to extract useful information
  - Recent policies impact on emissions reduction (175 GW of RE; EE)
  - Tight clustering of post 2015 projections: Doubling of CO_2, consistent with pledge of 33-35% reduction in emissions intensity from 2005 levels
- Per capita
  - India's 2030 per capita projections (2.5-3.6 T/cap), after two decades of steep rise in absolute emissions, below the 2014 global average of 4.7 T/cap

Doubling of CO2 emissions (2030) as upper bound

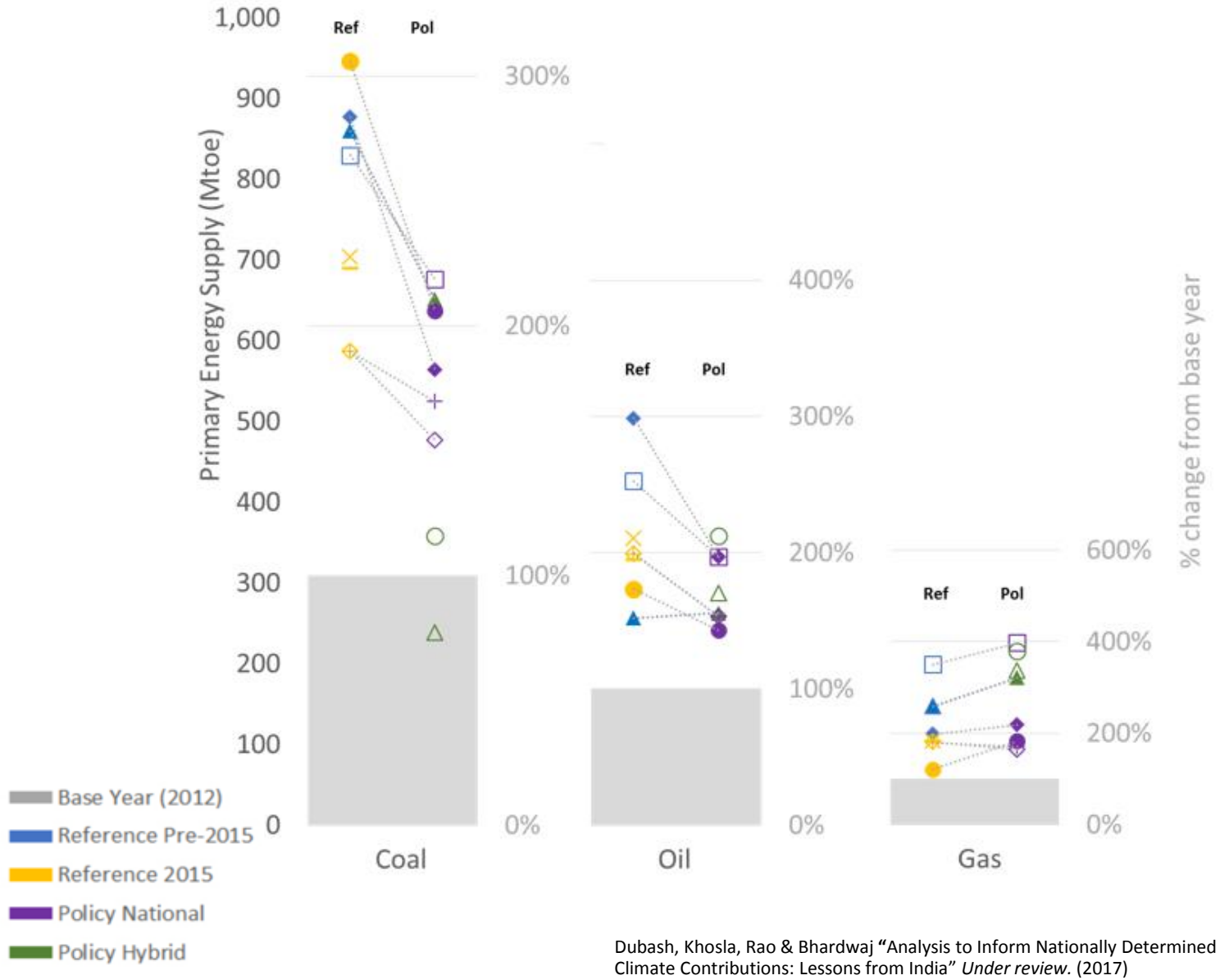
- Post-2015 scenarios best capture current policy environment
- Studies assume partial (realistic) not full policy implementation, latter would lower emissions
- Assume average GDP rates 7-7.5% until 2030 (higher than historical rates of 6-7%) – likely lower rates would lower emissions

- Doubling of 2012 CO2 emissions from energy by 2030 == 43% of China's 2015 emissions

Underlying future energy trends: Supply-side

- Coal remains dominant through 2030
  - Doubling or more in reference/policy scenarios
  - Swamps oil and gas rise

- Future supply requires untangling the inter-connected projections of coal use and renewable energy growth



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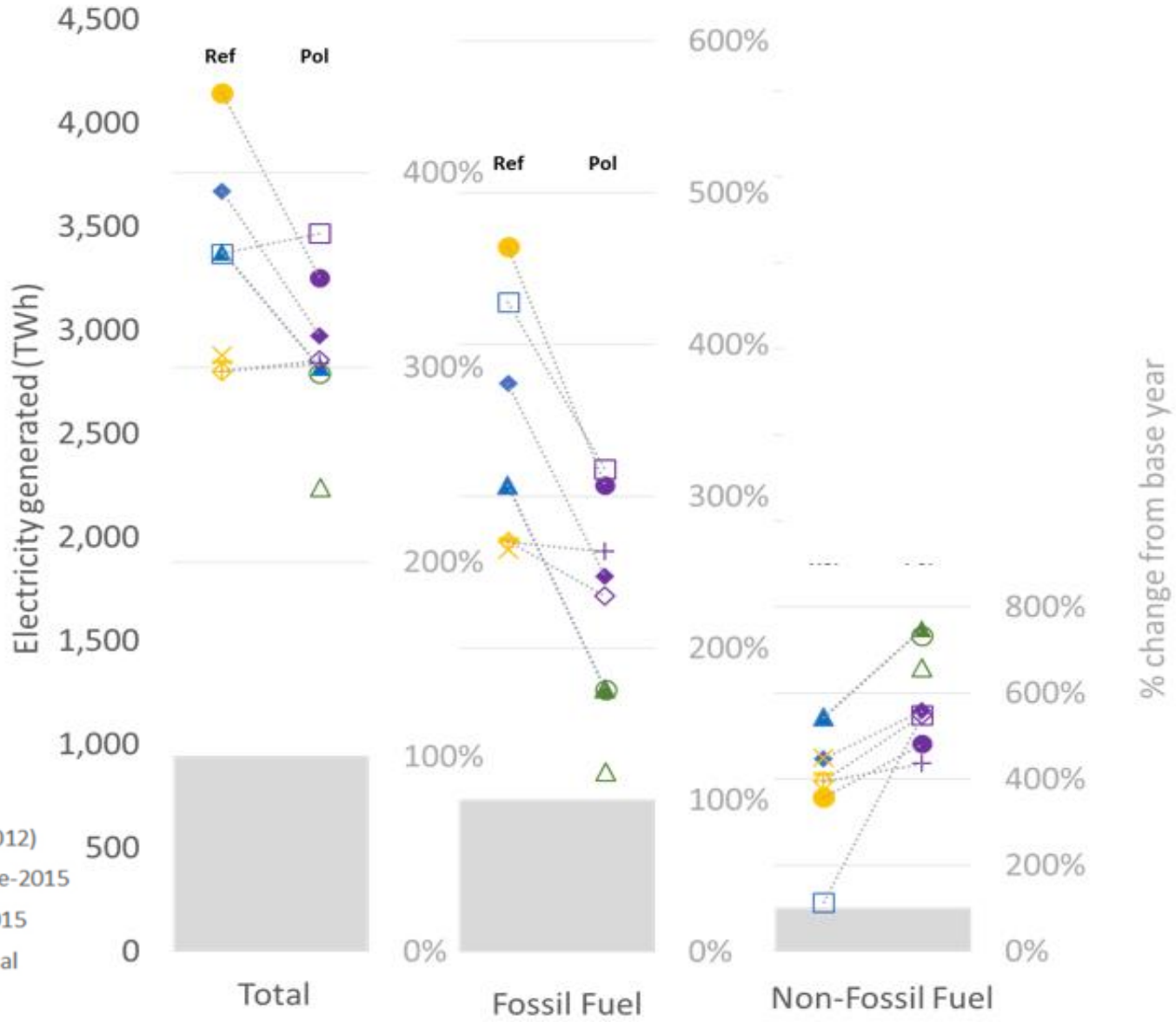
Underlying future electricity sector trends

- Electricity = 49.6% of CO_2 emissions from energy (2012)
  - Pace of decarbonisation key to extent of FF displacement
- High rates of non-fossil fuel electricity growth, from RE
- Total electricity demand rises faster than overall RE growth, with FF growth
  - But at what rate?



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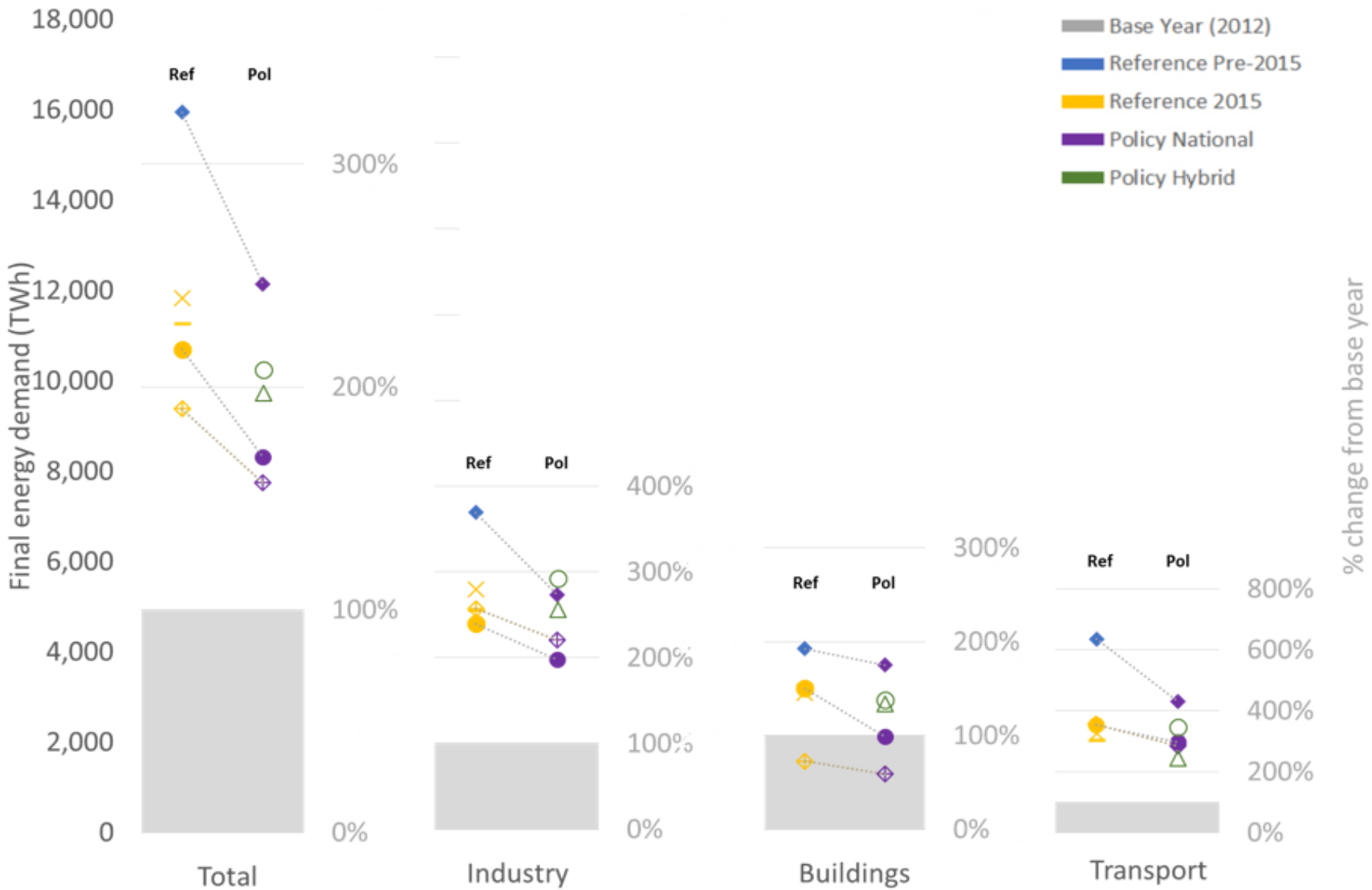
Diminishing interest in coal?

- Mixed signals on coal
  - 2014: 1500 MT coal consumption target for 2022 (Ministry of Coal)
  - 2016: Only 25% increase in existing coal fleet (44 GW) until 2027 (National Electricity Plan)
  - 2017: National Energy Policy coal growth of 330-441 GW by 2040 (NITI Aayog)
- Declining private sector attractiveness, increasing coal investment risk
  - Falling RE costs (Solar: 17.91 INR/kWh in 2011 to 2.44 INR/kWh in 2017)
  - Cancellation of plants because of surplus requirements
  - Air and water pollution impacts
- A lower carbon future than currently projected..
  - Contingent on demand

Future energy demand trends

- Demand increases as India transitions
  - 2015 policies reduce demand
- Recent trends suggest lower demand
  - Electric Power Survey dropped projections for 2027 by 25% between 2012-2017
- Magnitude of demand growth is *contingent*
  - Electric vehicles in 2030
  - Extent of EE



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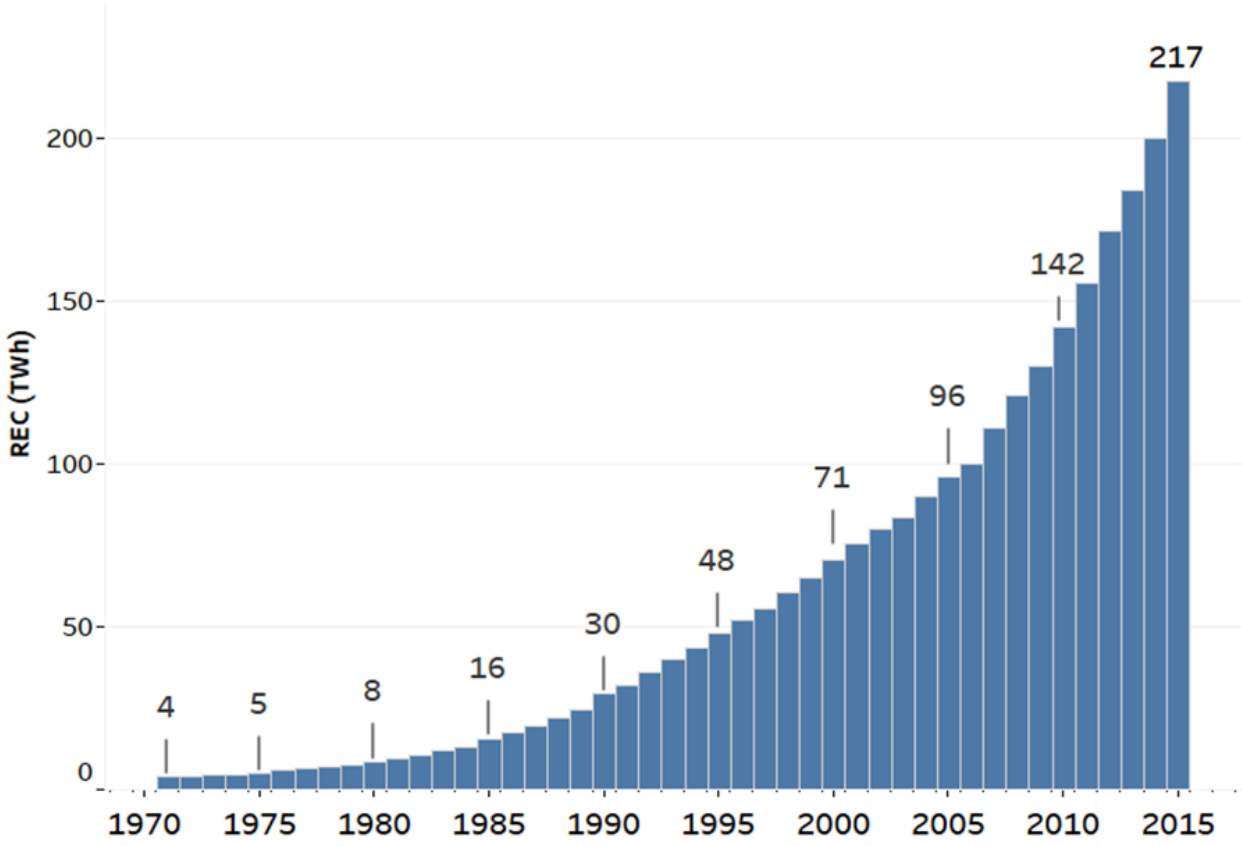
Unpacking energy demand: Bottom-up

- Model and policy predictions demonstrate variability in demand and role of immediate interventions
- Salient elements of energy planning oriented towards supply
- But transitions pose a real risk of accidental 'lock-in' to consumption patterns, since the bulk of development is yet to occur
  - Buildings, transport, industry can form up to 23-25% of reduction in emissions intensity from 2005 levels by 2020 (Planning Commission)
- Necessary for sensible supply-side planning
  - 40% non-FF electricity by 2030: But based on 650 or 1000 GW grid?
- Focus on residential electricity demand

Scale of residential electricity use

- 85% of floor space in 2050 to be residential
- Residential electricity consumption increased 50 times since 1971
- Residential uses ~25% of total current electricity
  - With quarter of households with no electricity
- Projected to increase 5-6 times btw 2014-2030 with rapid electrification, increasing incomes, and tech development

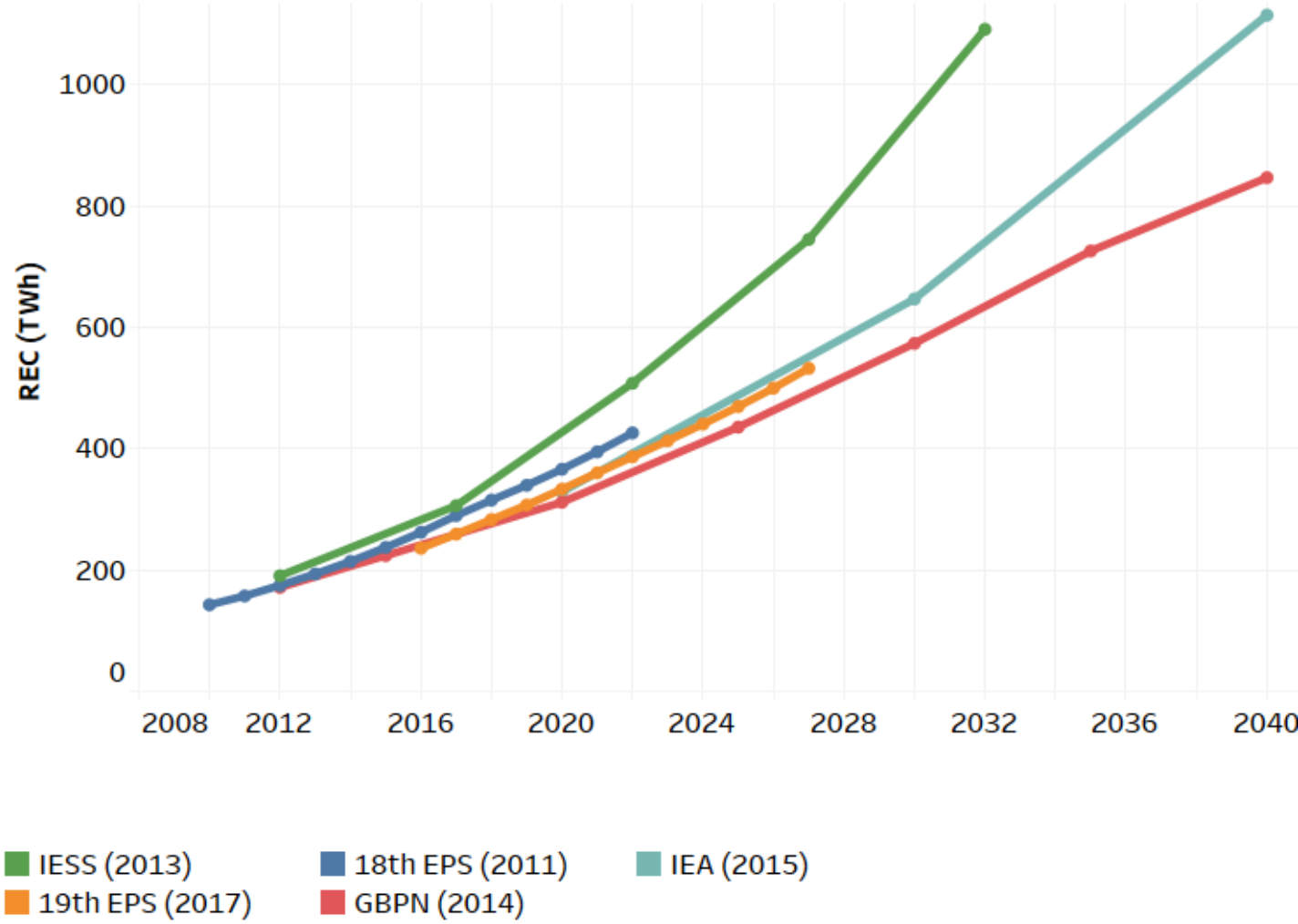


Source: Ministry of Statistics and Programme Implementation & Central Electricity Authority data; Prayas (2016)

But limited understanding of household consumption

- Large variation in projections from varying methods, assumptions, base years

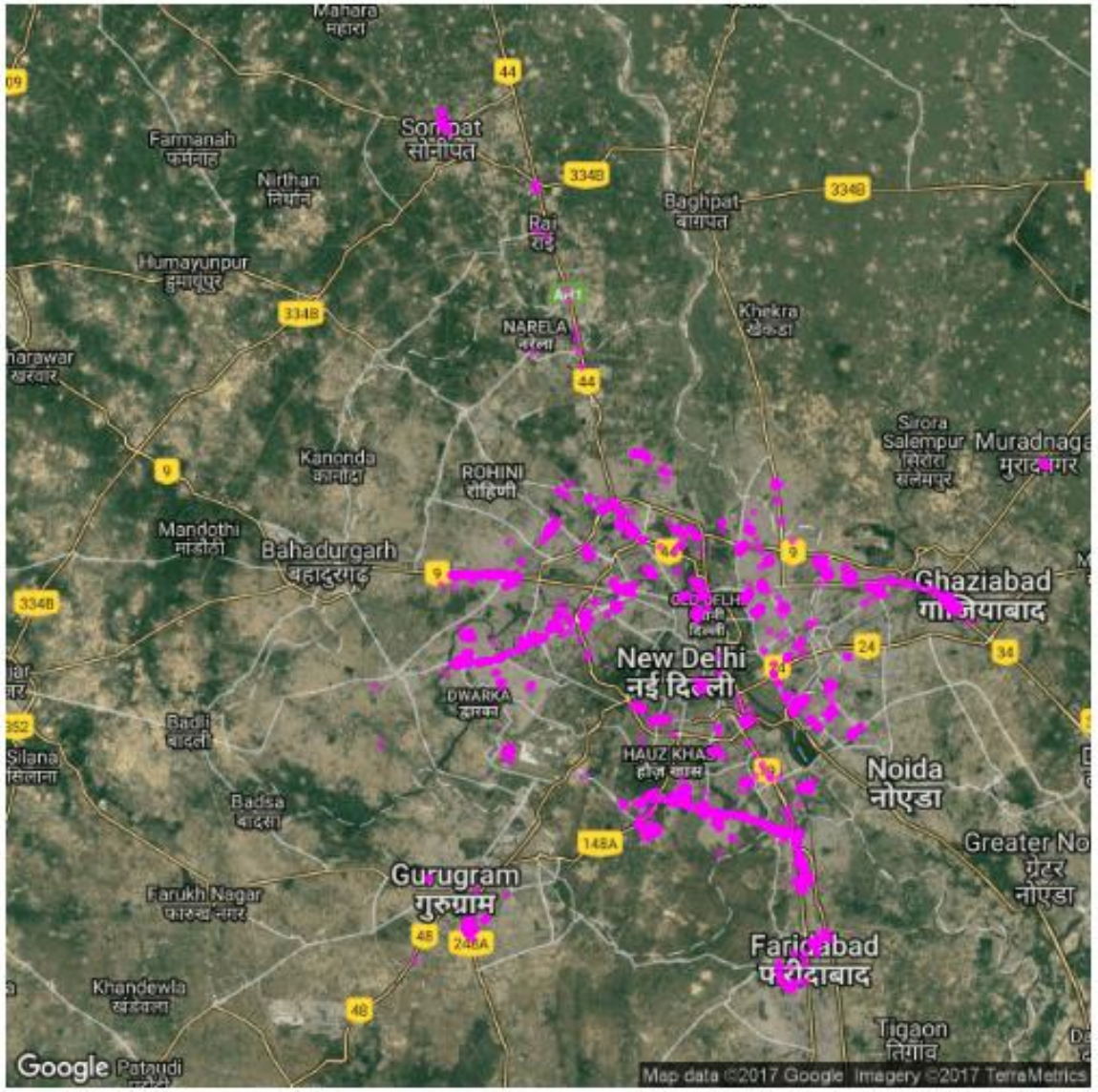
- Lack of knowledge significant barrier to estimating demand, planning appropriate supply, and managing climate mitigation



Source: Prayas (2016)

Case study: Energy services in the National Capital Region

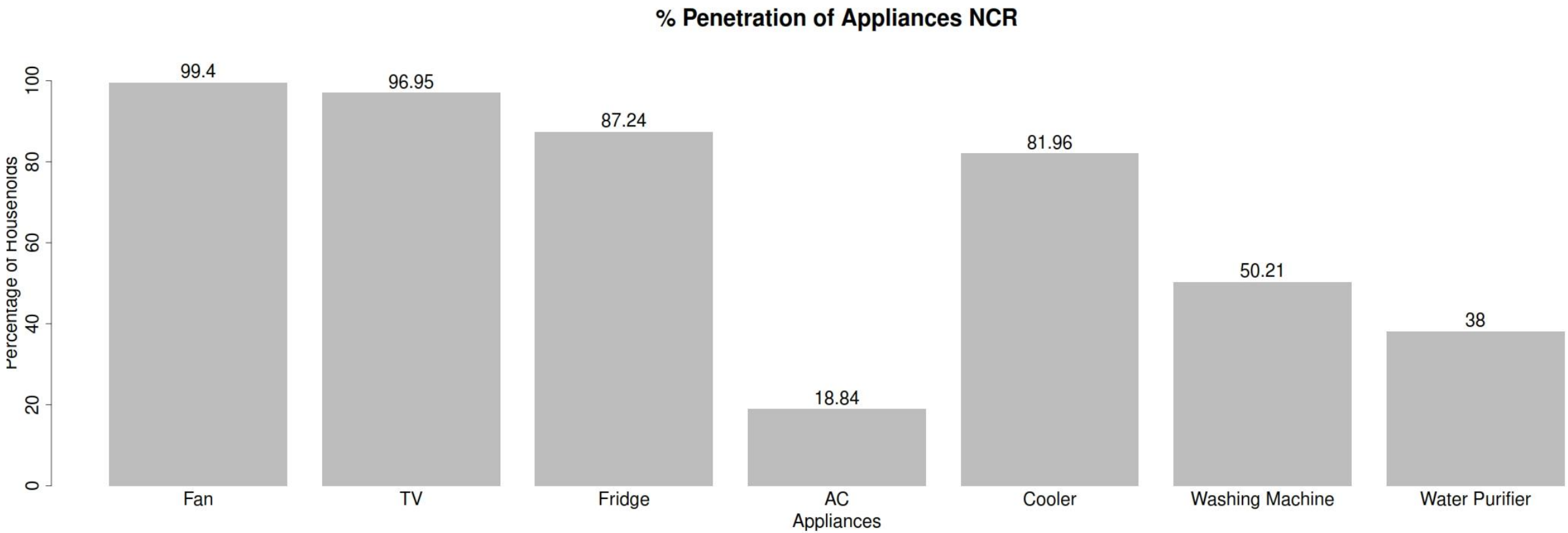
- National Capital Region (NCR): Delhi, Haryana, Uttar Pradesh, Rajasthan
  - Approx. 30 million (approx. 130 cities/towns)
  - 22,500 sq miles
  - Population growth 20% per decade
  - ~5500 households surveyed



Per- capita consumption perspective

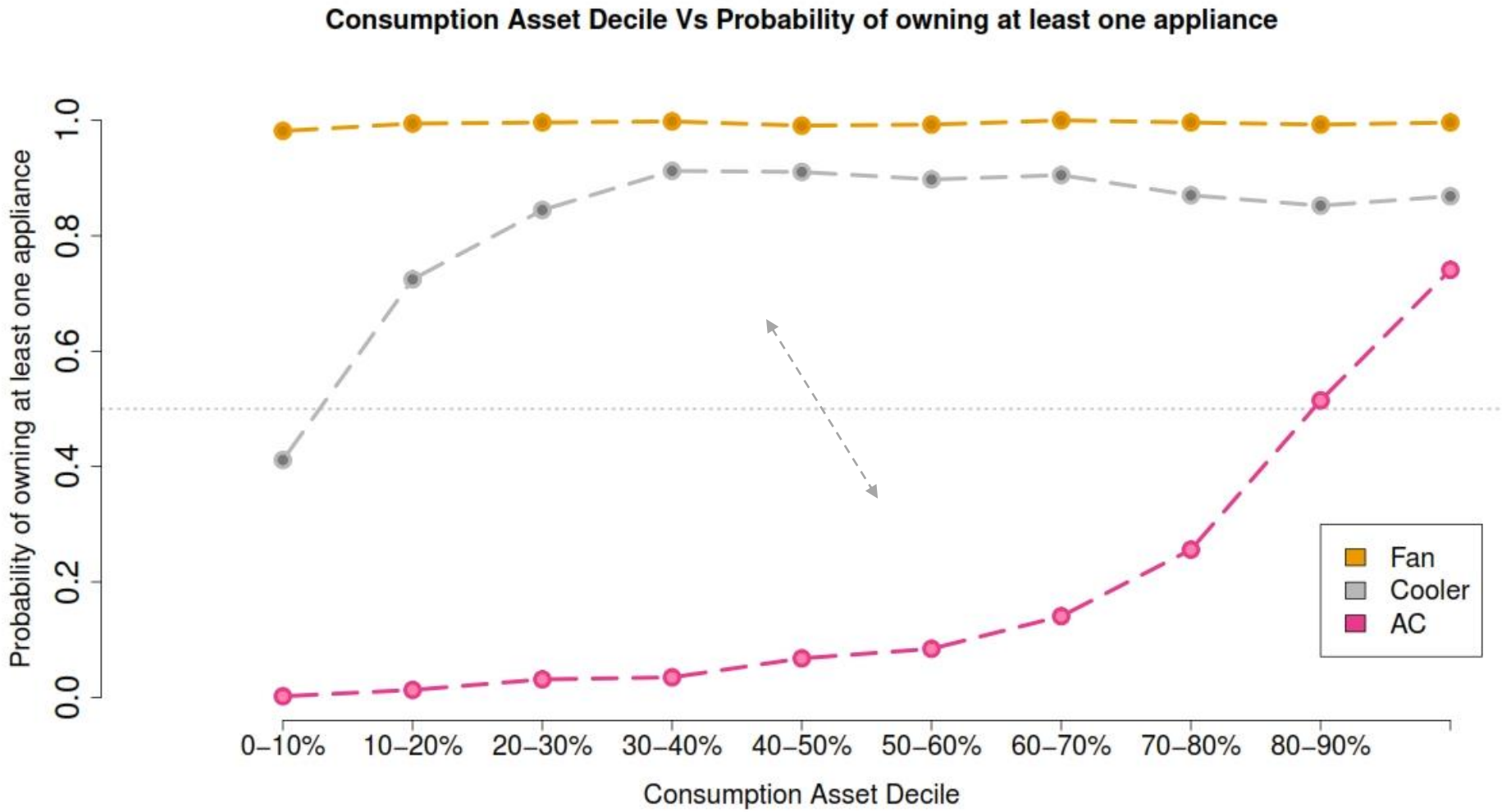
	Annual per capita residential elec. use (KWh)	Year	Source
USA	4413	2014	Prayas, 2016
	4376	2015	EIA, 2017; US Census Bureau, 2017
China	512	2014	Prayas, 2016
	550	2015	NBSC, 2017
India	153	2014	CEA (Prayas, 2016)
	174	2015	Niti Aayog, 2017
Delhi	550	2012	CEA (Prayas, 2016)
	606	2015	Niti Aayog, 2017
NCR	611	2016	CASI Survey, 2016-17

Which electricity services drive NCR consumption?



Source: CASI NCR Study, 2017

Appliances ladder: Ownership of a cooling device



Source: CASI NCR Study, 2017

Unpacking the residential demand transition

- Fans, TV and Fridges most prevalent elec. consuming appliances
  - *None* with scaled energy efficiency programs
- Cusp of exponential growth in AC market
  - Fan load: 60-100 W; Cooler load: 60-200 W
  - AC load: 1500-2000 W
- Impending increased load projections (*LBL, AEEE*)
  - ACs to add 150 GW to peak demand by 2030 (= 300 500-MW power plants)
  - Appliances to add 300 GW or 60-70% of the projected total peak load by 2030
  - Potential to reduce peak load demand 20-50%
- Once transition made, reversing investment decisions and consumption pathways prohibitive

Conclusions

- India is poised on the edge of an energy transformation
  - Enormous unmet energy needs; early stage of infrastructure development
  - Rapid global energy and information technological change
  - Global and national pressures re: energy sources and climate obligations
- Doubling of CO_2 emissions (from 2012) likely upper bound
  - Consistent with Paris pledge
  - Per capita emissions remain low
- Faster than expected transition from coal to renewables
- Scope for reduced rate of emissions growth by focusing on end-use demand
- Challenge for India is to decarbonise, increase energy access and use, address development, simultaneously under fluid demographic and urban transitions..

Thank you

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