OXFORD INSTITUTE FOR ENERGY STUDIES

Electricity Market Liberalisation in Advanced Developing Countries

An Alternative Approach

Oxford Energy Seminar

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Overview

Standard Liberalisation Model

Why SLM Fails

An Alternative ADC Model

Standard Liberalisation Model

Indian state owned power sector is jeopardising the industrial development of India

ELECTRICITY AS A DEVELOPMENT PROBLEM

- Around 2 billion people without electricity worldwide (500,000 million in India)
- Enhance productivity and competitiveness
- Enable education
- Improve water supplies & health

BUT…

- Require $200 billion new capital to provide just 100W to each person

Standard Liberalisation Model

India features the key issues facing many Advanced Developing Countries (ADCs)

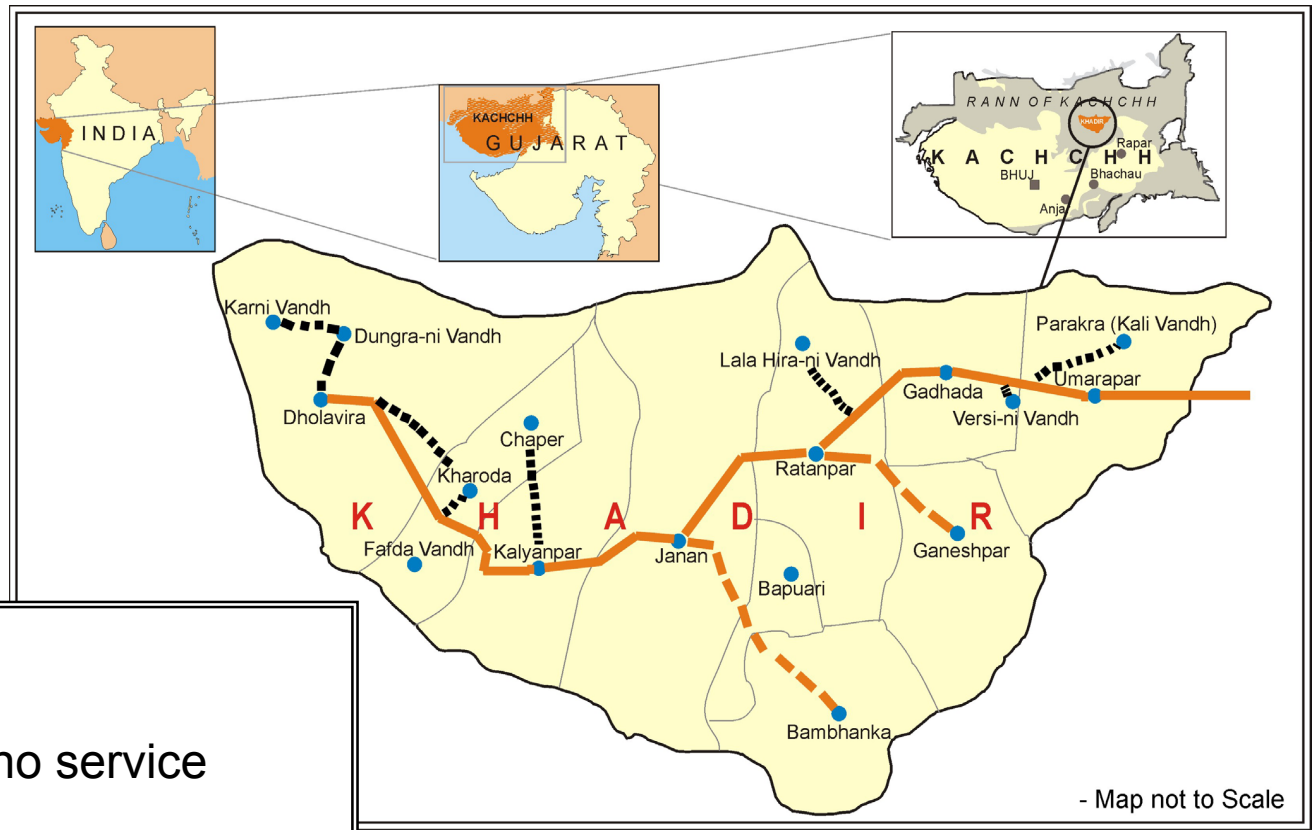
INDIAN ELECTRICITY SECTOR PROBLEMS

• Market Structure	Inefficiency & Over-employment
• Tariff Policy	Subsidised agriculture/household and high industrial tariffs
• Grid Stability	Many regional transmission failures
• T&D losses	20% technical and 30% non-technical (theft) in some states
• Financial	SEBs bankrupt and losing $9 billion p.a.
• Power Shortages	Rapid demand growth and peak loads not being met

Standard Liberalisation Model

Begun a 3 year study to look at alternatives to Standard Liberalisation Model (SLM)

GUJARAT PROJECT

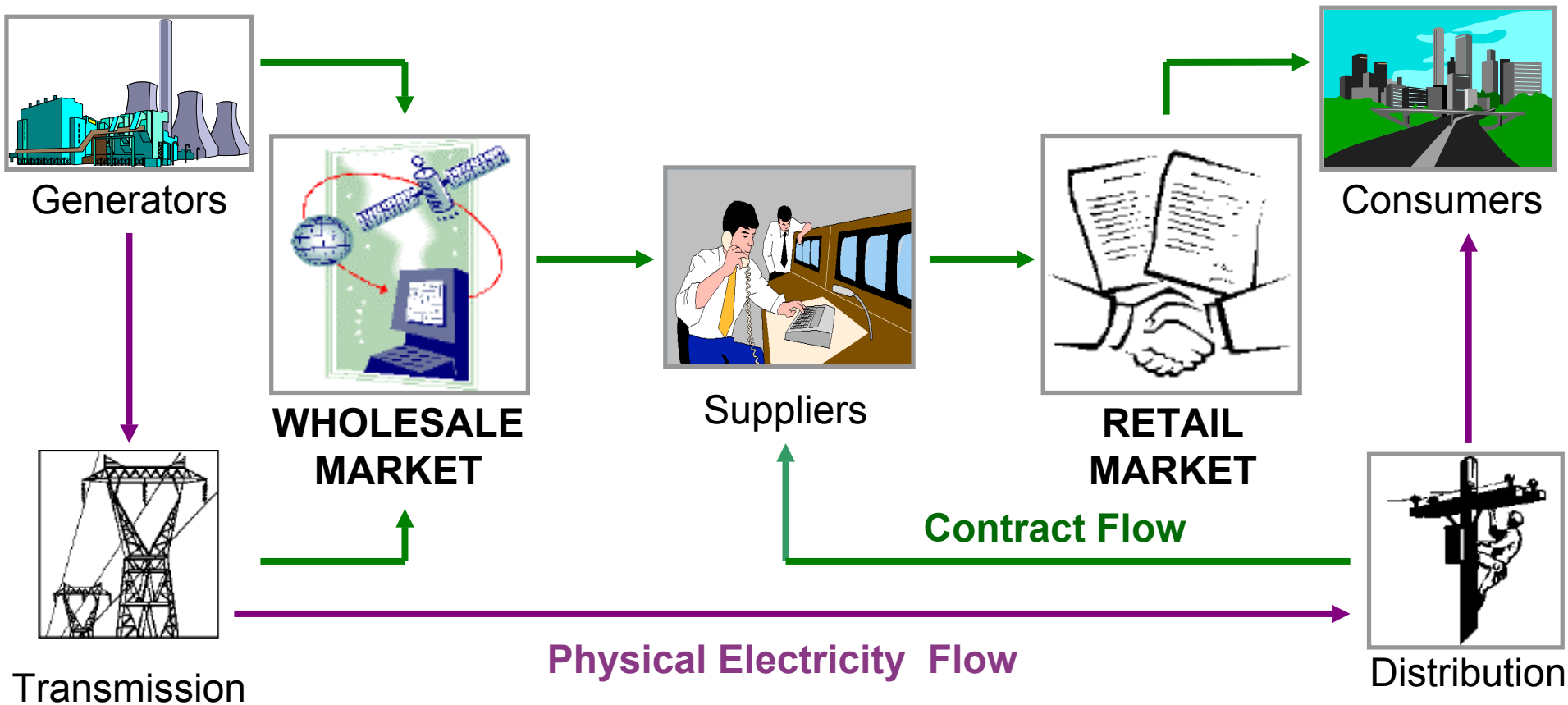


- "100% electrification"
- 46% of rural houses have no service
- Per capita consumption p.a. = 834 kWh (354 kWh all India and 9859 kWh in USA)

Standard Liberalisation Model

Liberalisation means wholesale / retail markets replace government control and ….

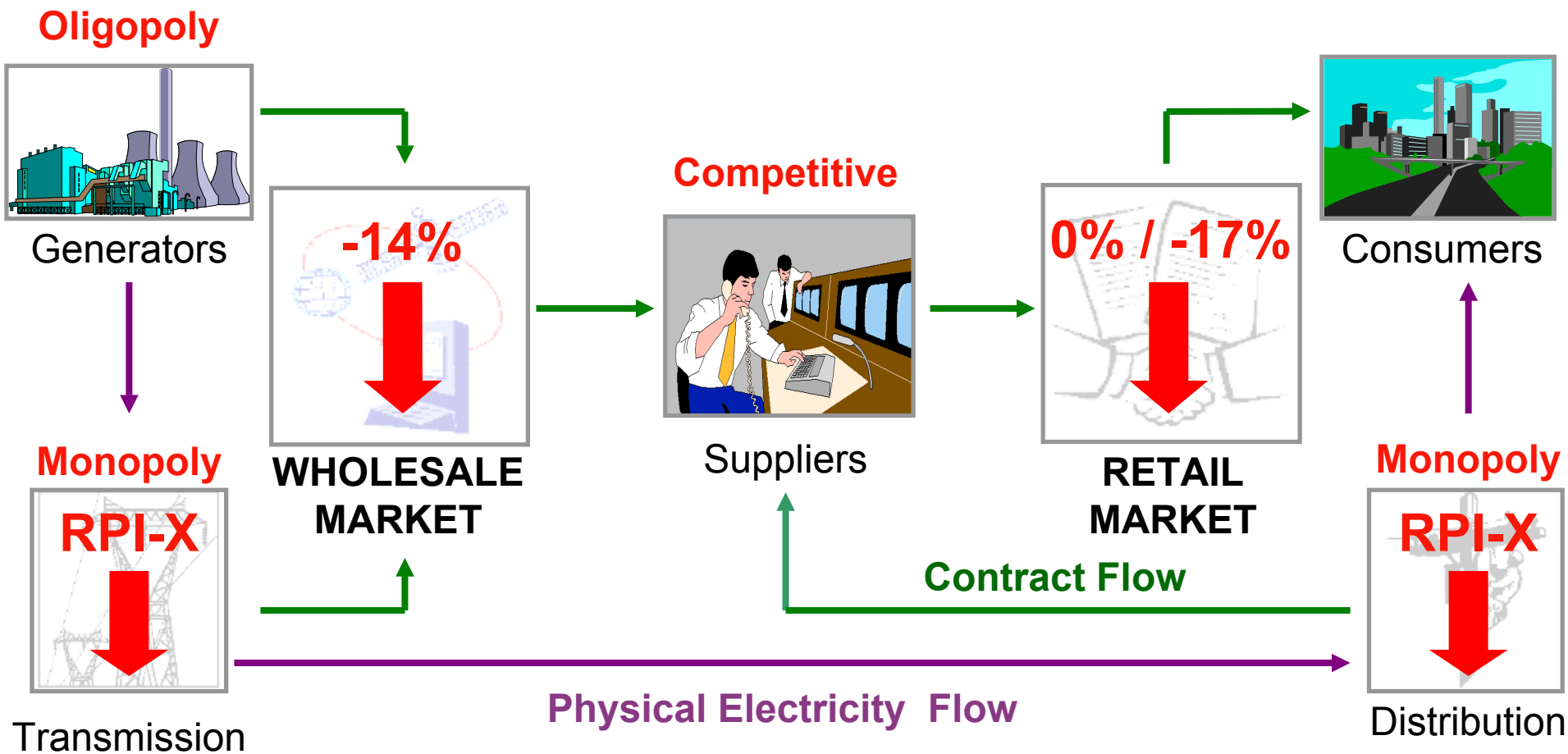
STRUCTURE OF A LIBERALISED ELECTRICTY MARKET



Standard Liberalisation Model

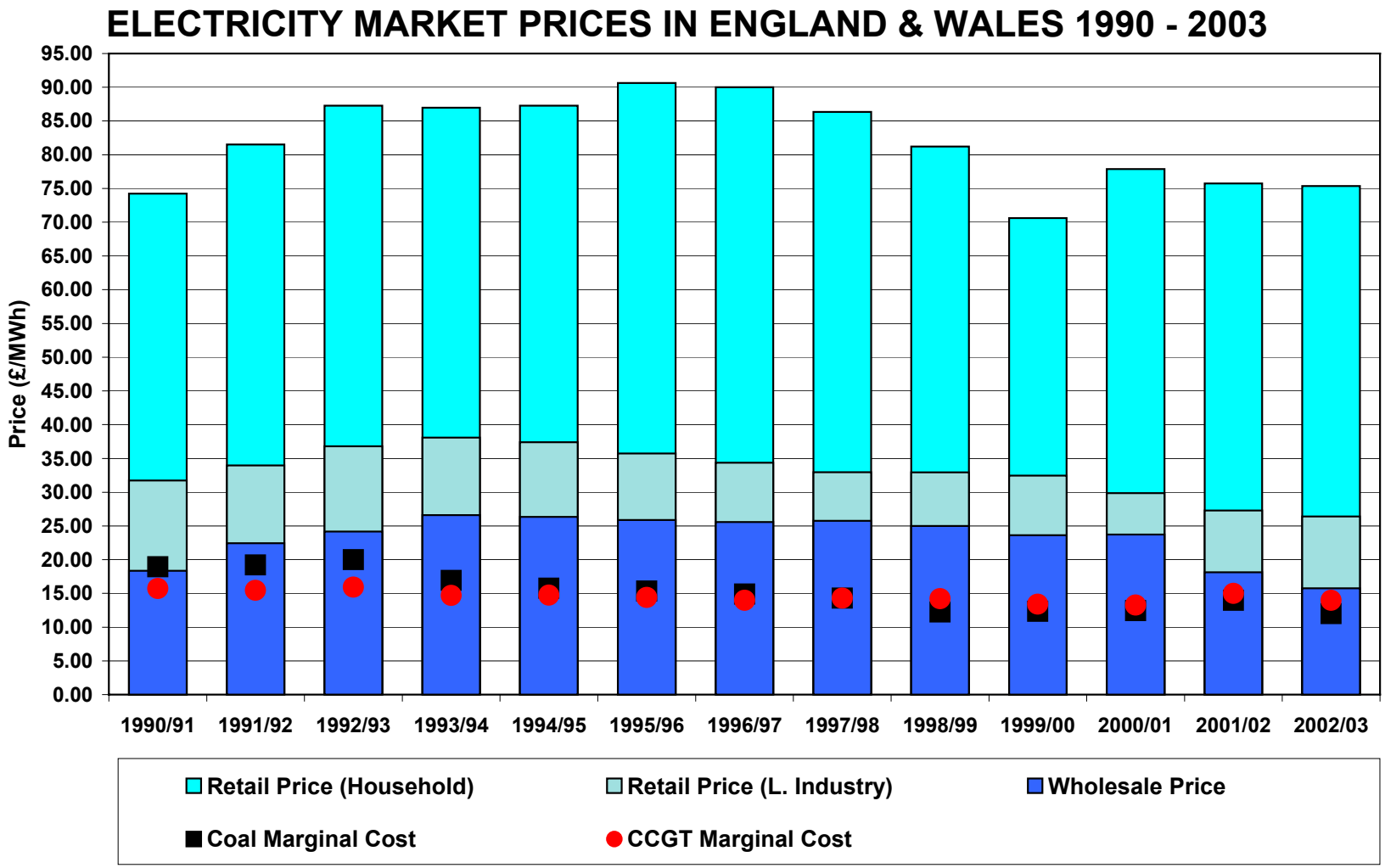
…. in theory new entrants and increased efficiency should reduce consumer prices….

IMPACT OF LIBERALISATION IN ENGLAND & WALES 1990 - 2003



Standard Liberalisation Model

…. but this outcome is not guaranteed if firms can exercise market power …



Source: OIES estimates based on E&W Pool, UKPX, DTI data

Why SLM Fails

SLM will tend to fail (even in OECD countries) if critical success factors missing

SLM SUCCESS FACTORS

ELECTROMECHANICAL

1. Large system > 5 GW available generation capacity
2. Peak demand 15% < available generation capacity
3. Fully interconnected, reliable, and 'overbuilt' transmission and distribution system

SOCIOPOLITICAL

1. Existing retail prices must be above competitive future (unsubsidised) prices
2. Acceptance of less state control in energy and break-up of 'national champions'
3. Separation of 'social good' from 'economic input' aspects

Why SLM Fails

Only 50-60 countries are big enough for SLM ….

COUNTRY RANKING OF INSTALLED GENERATION CAPACITY (GW)

1	United States	812.7
2	China	329.9
3	Japan	234.5
4	Russia	204.2
5	Germany	113.7
6	India	111.8
7	France	111.3
8	Canada	111.1
9	United Kingdom	76.3
10	Brazil	73.4
11	Italy	68.5
12	Ukraine	53.7
13	Korea, South	52.1
14	Spain	47.8
15	South Africa	44.7
16	Australia	42.7
17	Mexico	40.5
18	Sweden	32.8
19	Iran	30.6
20	Poland	30.6
21	Taiwan	29.6
22	Norway	27.9
23	Turkey	27.3
24	Argentina	25.9
25	Saudi Arabia	23.8
26	Romania	22.6
27	Venezuela	21.2
28	Netherlands	21.1
29	Indonesia	20.8
30	Thailand	20.8
31	Pakistan	17.7
32	Egypt	17.7
33	Kazakhstan	17.2
34	Finland	16.2
35	Switzerland	15.7
36	Czech Republic	15.2
37	Belgium	14.4
38	Austria	14.3
39	Malaysia	13.8
40	Philippines	13.2
41	Colombia	12.7
42	Denmark	12.7
43	Bulgaria	11.9
44	Uzbekistan	11.7
45	Portugal	10.3
46	Greece	10.3
47	Chile	9.7
48	Yugoslavia	9.6
49	Korea, North	9.5
50	Israel	9.1
51	New Zealand	8.5
52	Kuwait	8.5
53	Hungary	8.3
54	Belarus	7.5
55	Slovakia	7.5
56	Paraguay	7.4
57	Singapore	6.7
58	Peru	6.1
59	Algeria	6.0
60	Nigeria	5.9

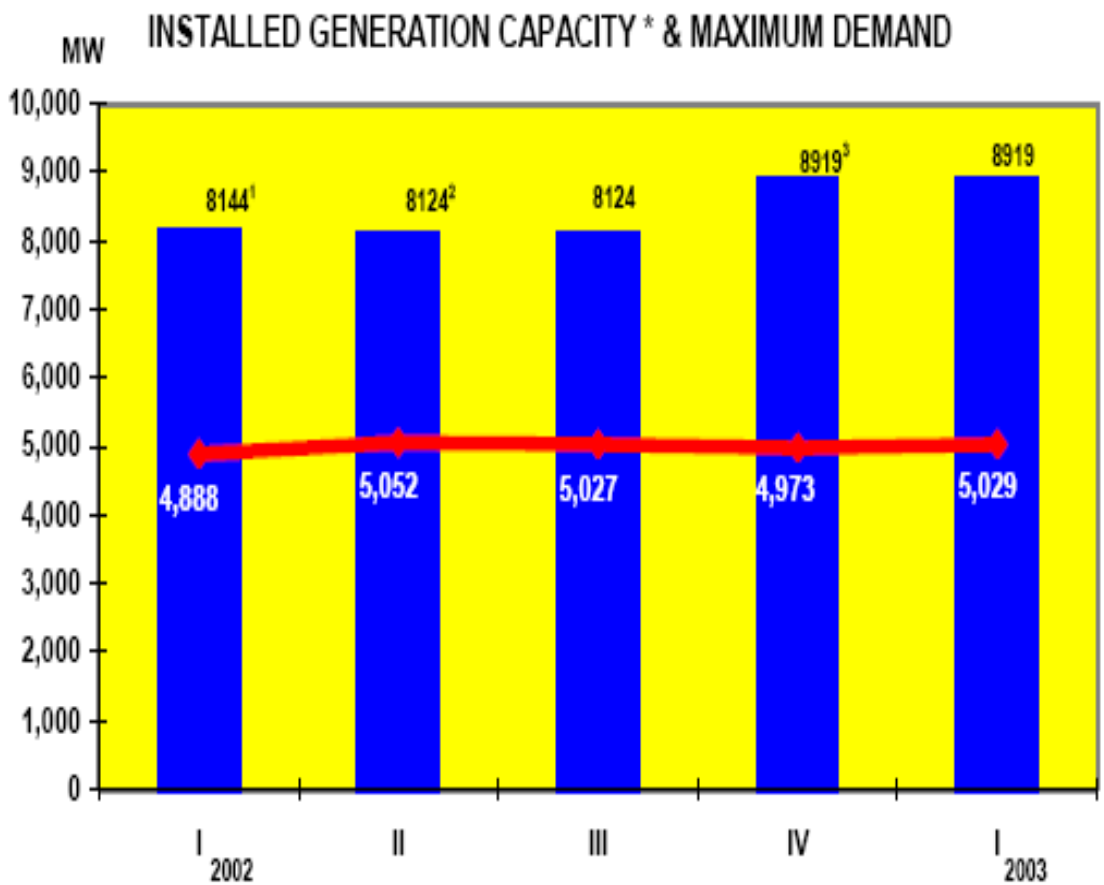
Source: Energy Information Administration (www.eia.doe.gov)

Why SLM Fails

…. as wholesale competition in small systems with big power plants is very difficult

SINGAPORE ELECTRICITY SYSTEM

Senoko Power	3300 MW
PowerSeraya	3100 MW
Tuas Power	2670 MW
SembCorp Cogen	900 MW
Island Power	800 MW
Kepel Merlimau	470 MW
NEA	130 MW
TOTAL CAPACITY	



Source: Singapore Electricity Market Authority /www.ema.gov.sg/Electricity/statistics.php

Why SLM Fails

Interconnecting markets to create competition is possible if security issues are solved….

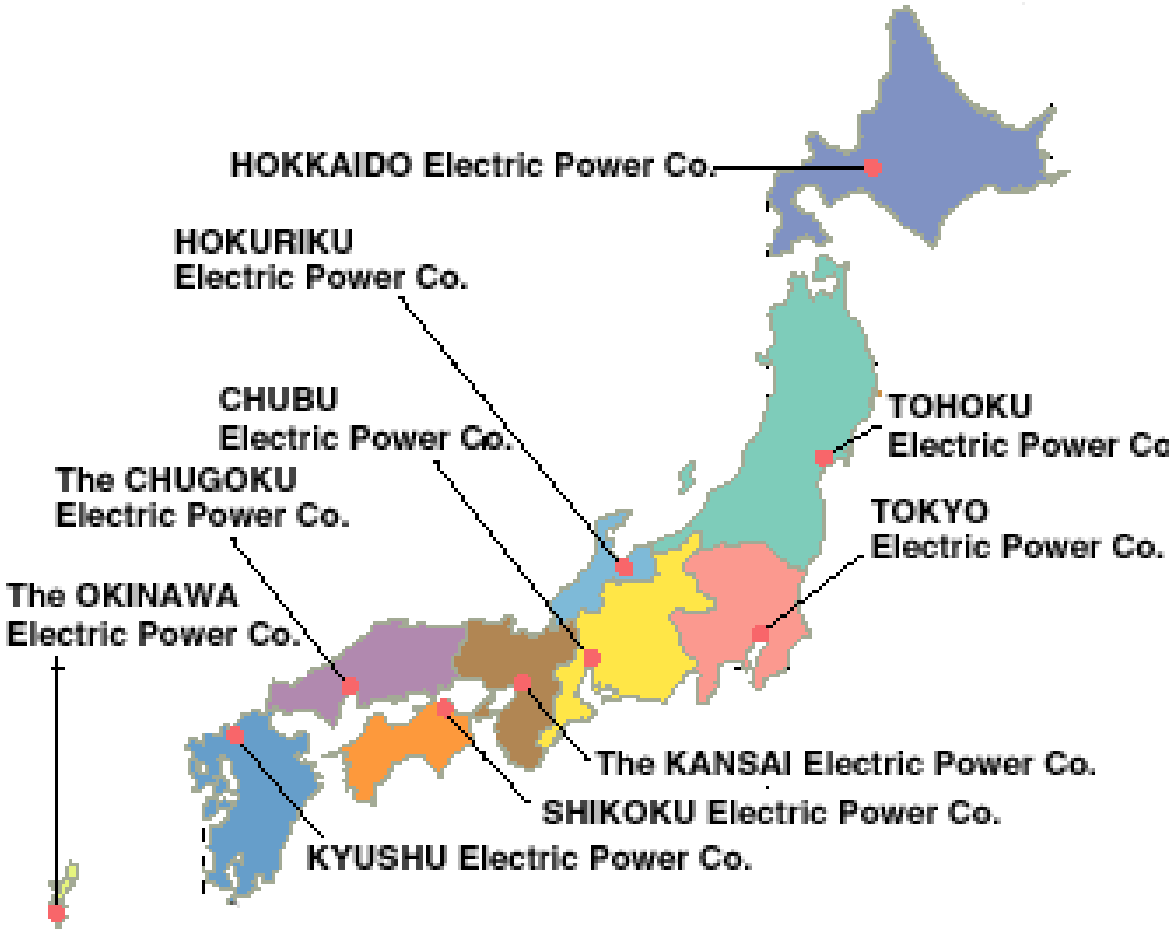
INTERCONNECTED EUROPEAN TRANSMISSION SYSTEMS

Source: CENTREL Annual Report 2001 (www.centrel.org)

Why SLM Fails

… but isolated transmission systems and near monopolies mean SLM is likely to fail

JAPANESE ELECTRIC UTILITIES (31 March 2002)

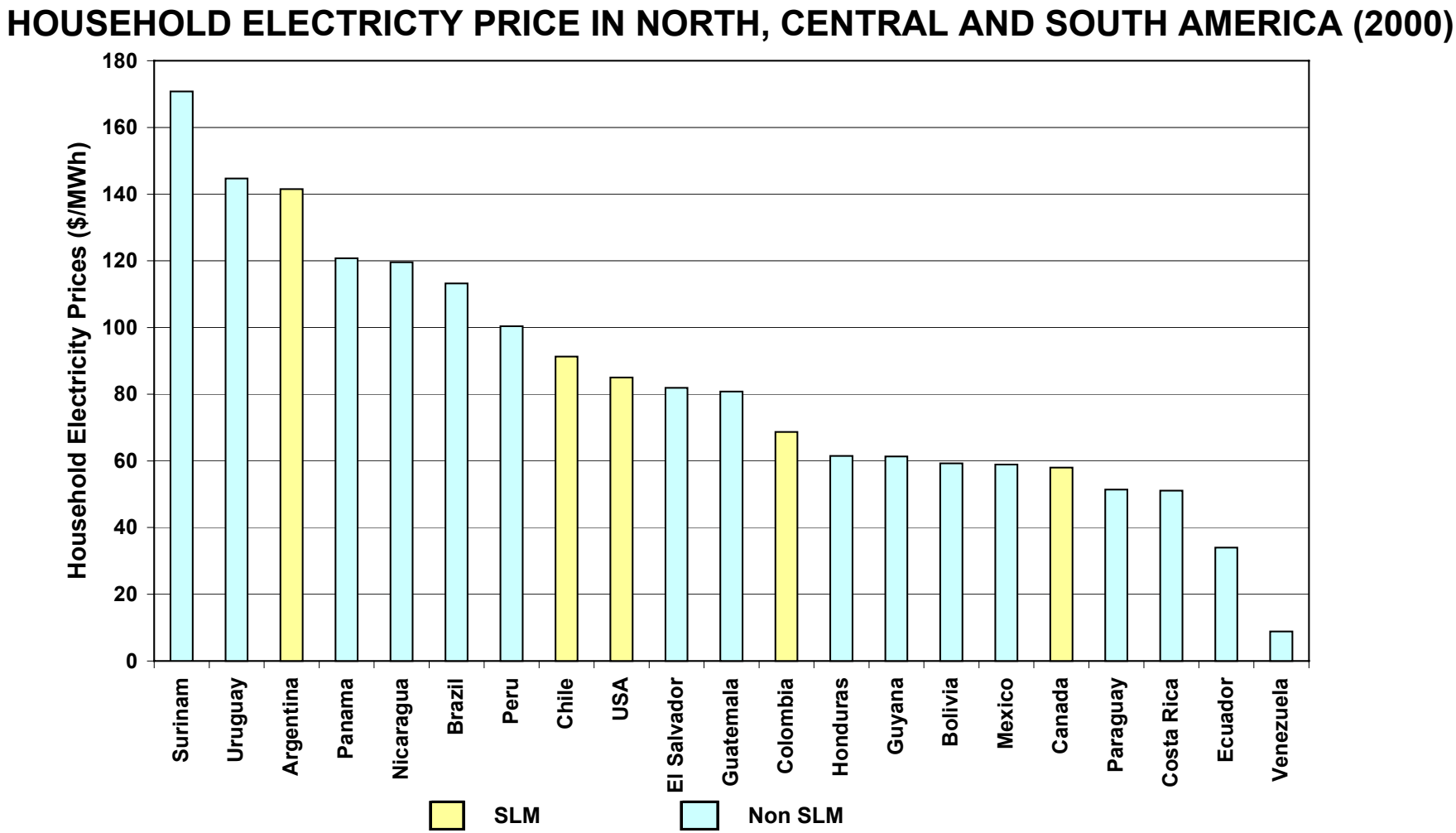


Source: JEPC Annual Review 2003-03 (www.fepc.or.jp/english/erj/chap02.html)

Company	Capacity (MW)	Interconnect (MW)	Interconnect (%)
Hokkaido	5904	100	1.7%
Tohoku	16076	800	5.0%
Tokyo	60375	700	1.2%
Hokuriku	6759	200	3.0%
Chubu	32231	500	1.6%
Kansai	35585	1400	3.9%
Shikoku	6877	400	5.8%
Chugoku	12179	500	4.1%
Kyushu	19336	300	1.6%

Why SLM Fails

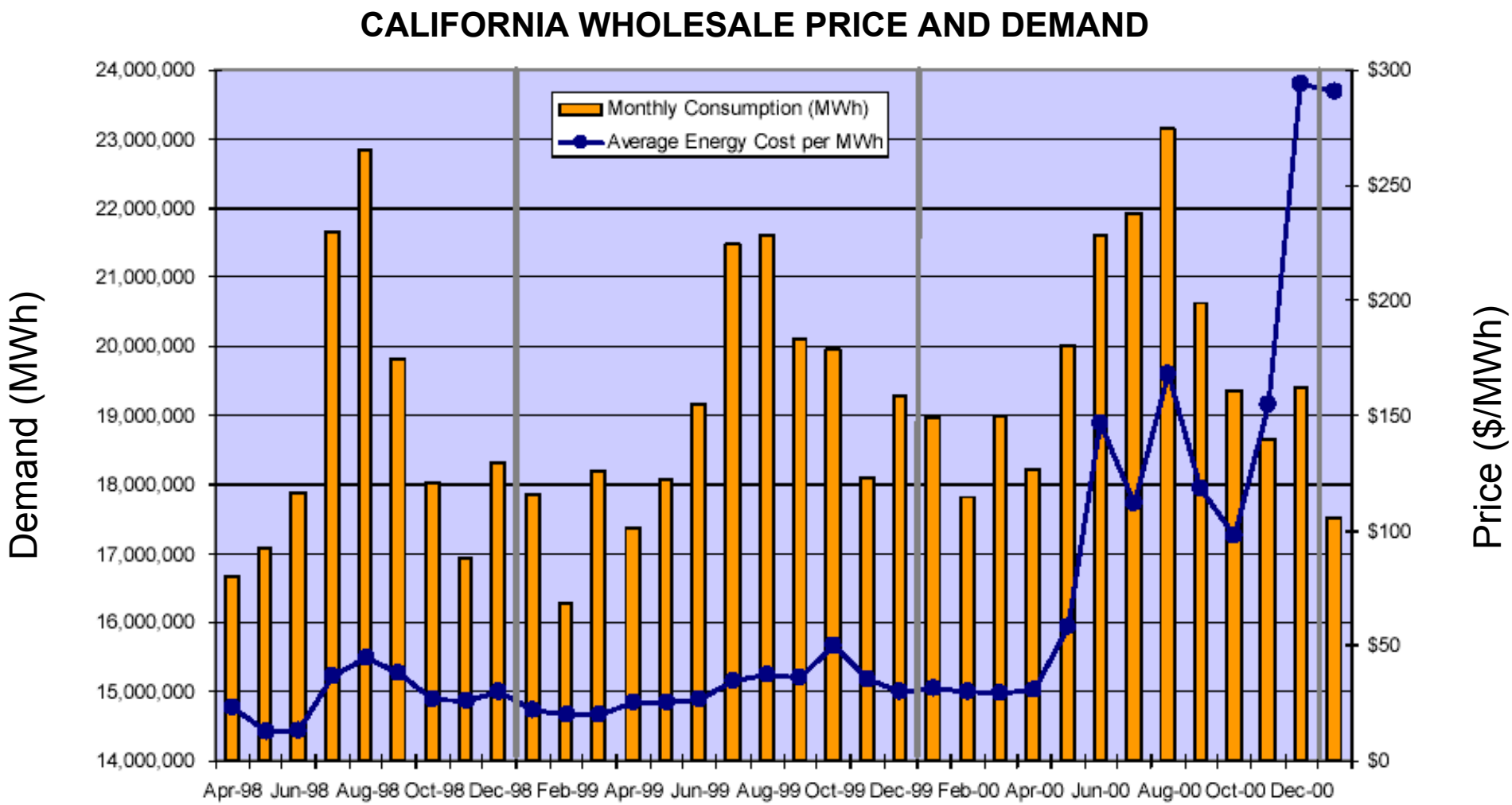
Liberalisation will only be politically supported if voters think prices will fall but….



Source: OLADE (www.olade.org/idiomas/ingles/sieehome/estadisticas/precios_internos.html) and IEA (Energy Prices & Taxes Q1 2003)

Why SLM Fails

…. demand exceeds supply and utilities bankrupt if retail price set below wholesale cost



Source: California ISO

An Alternative ADC Model

Previous policies failed in India but new Electricity Act will allow 'bottom up' reform

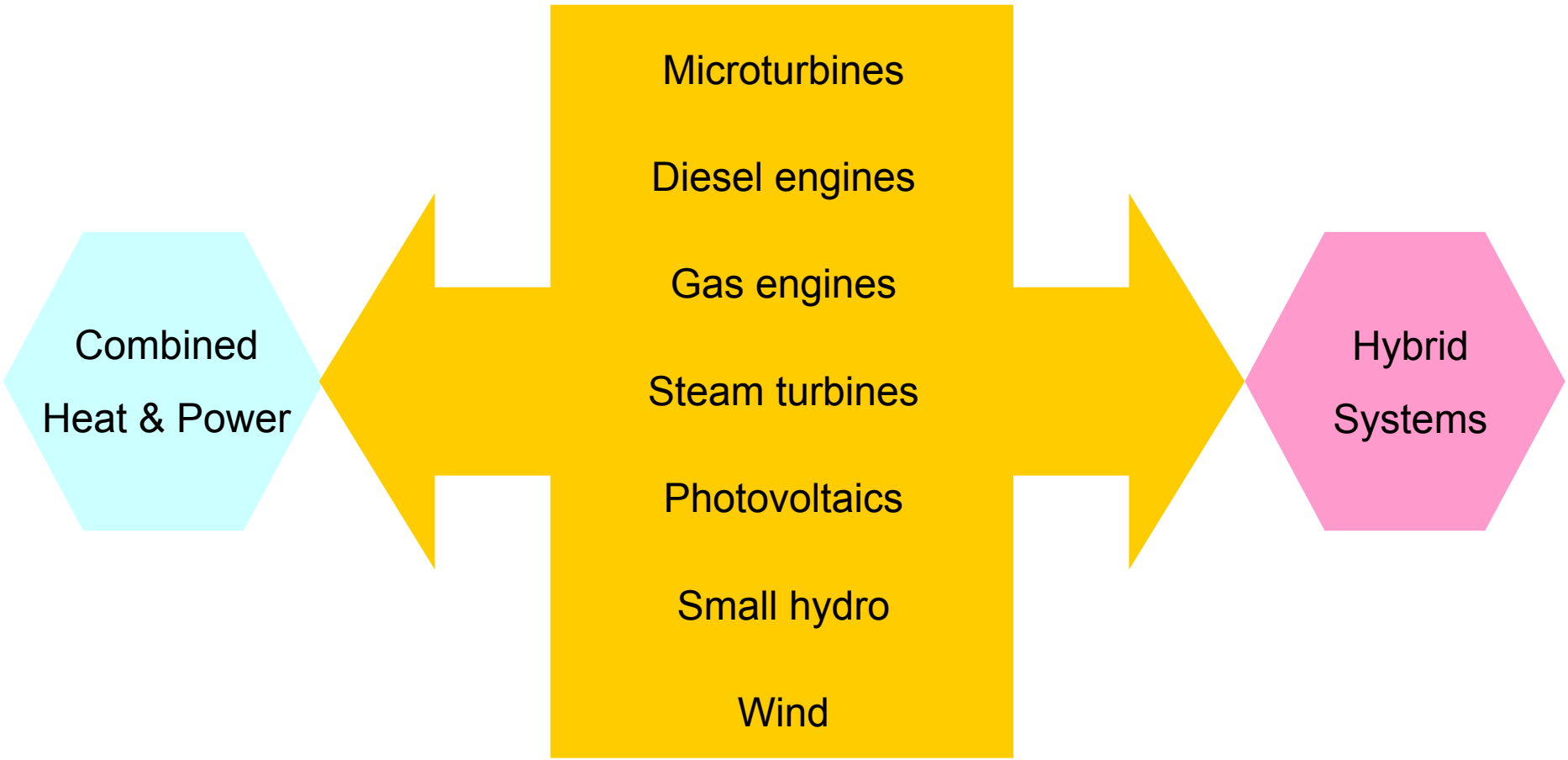
KEY ELEMENTS OF INDIAN ELECTRICITY ACT 2003

1. All power tariff subsidies must be explicitly in state budget (e.g. agriculture)
2. Special electricity theft tribunals
3. Interstate transmission rates set by CERC, NOT states → pit-head power export
4. Allows for reorganisation of the SEBs and creation of wholesale markets
5. License-free generation and distribution in rural areas, plus capital subsidies
6. Captive generation freely permitted
7. Open access to the T&D system
8. Phase out grid access surcharges

An Alternative ADC Model

Distributed generation (DG) is electricity production *near point of use* 3kW – 500MW….

DECENTRALISED GENERATION



An Alternative ADC Model

…. allows consumers to invest in and operate own DG as well as sell surplus power

CAPITAL COST AND CAPACITY OF DISTRIBUTED GENERATION

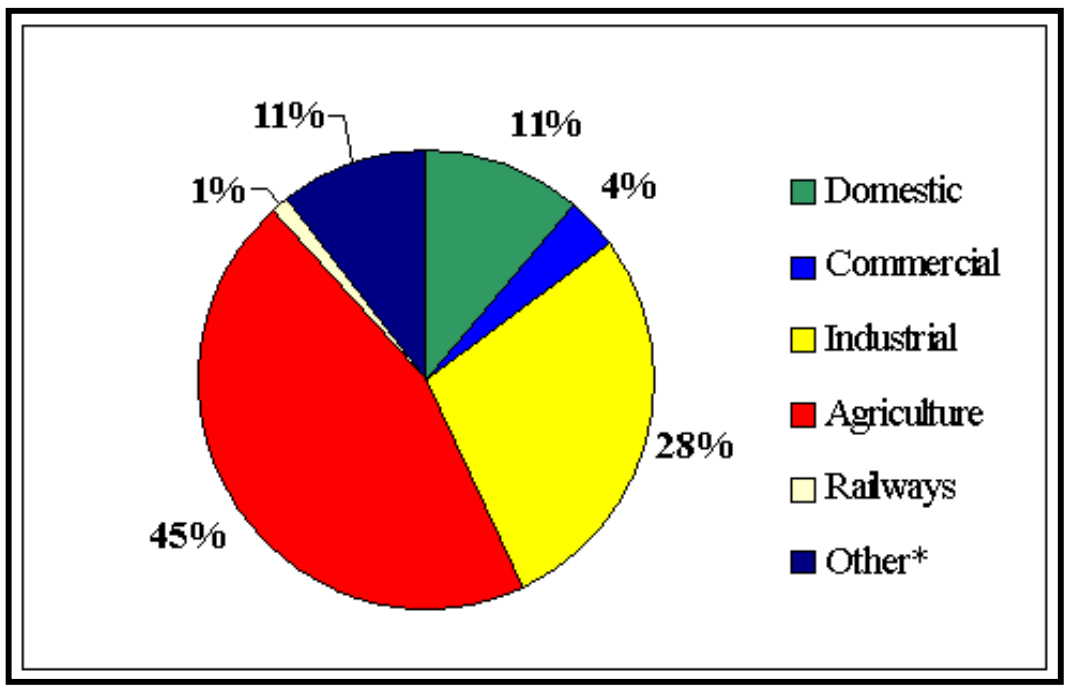
Diesel Generator		Gas Engine	Industrial CHP
			
20 kW	500 kW	4 MW	50MW + Heat
$9,000	$70,000	$1M	$50M
$450/kW	$140/kW	$500/kW	$1000/kW

An Alternative ADC Model

Industrial load has a big incentive to quickly leave the system ….

GUJARAT TARIFF STRUCTURE AND DEMAND 2001/02

$/kWh	Domestic	Commercial	Agriculture	Industrial	Rail	Other	Overall
Gujarat	0.040	0.077	0.004	0.078	0.093	0.034	0.040
India Avg	0.032	0.075	0.004	0.069	0.088	0.040	0.040



Comparative Costs

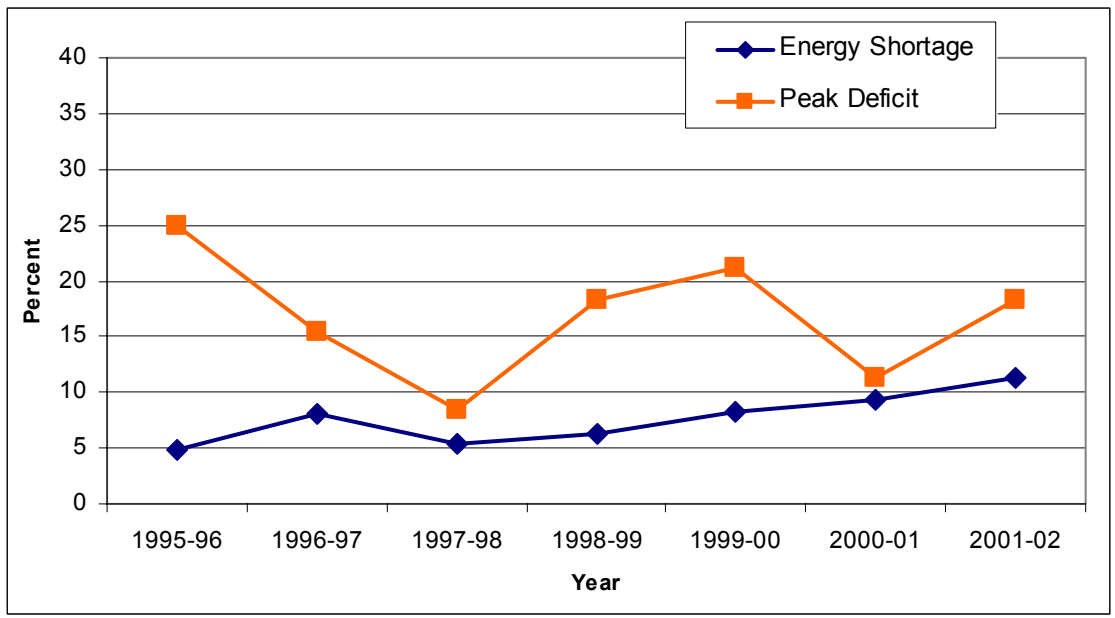
New CHP	$0.040/kWh
GEB ‘station gate’	$0.045/kWh
New Grid Connected	$0.172/kWh

An Alternative ADC Model

… this would reduce total demand and increase supply of surplus power back to grid

SHORTFALL IN MEETING PEAK AND TOTAL DEMAND IN GUJARAT

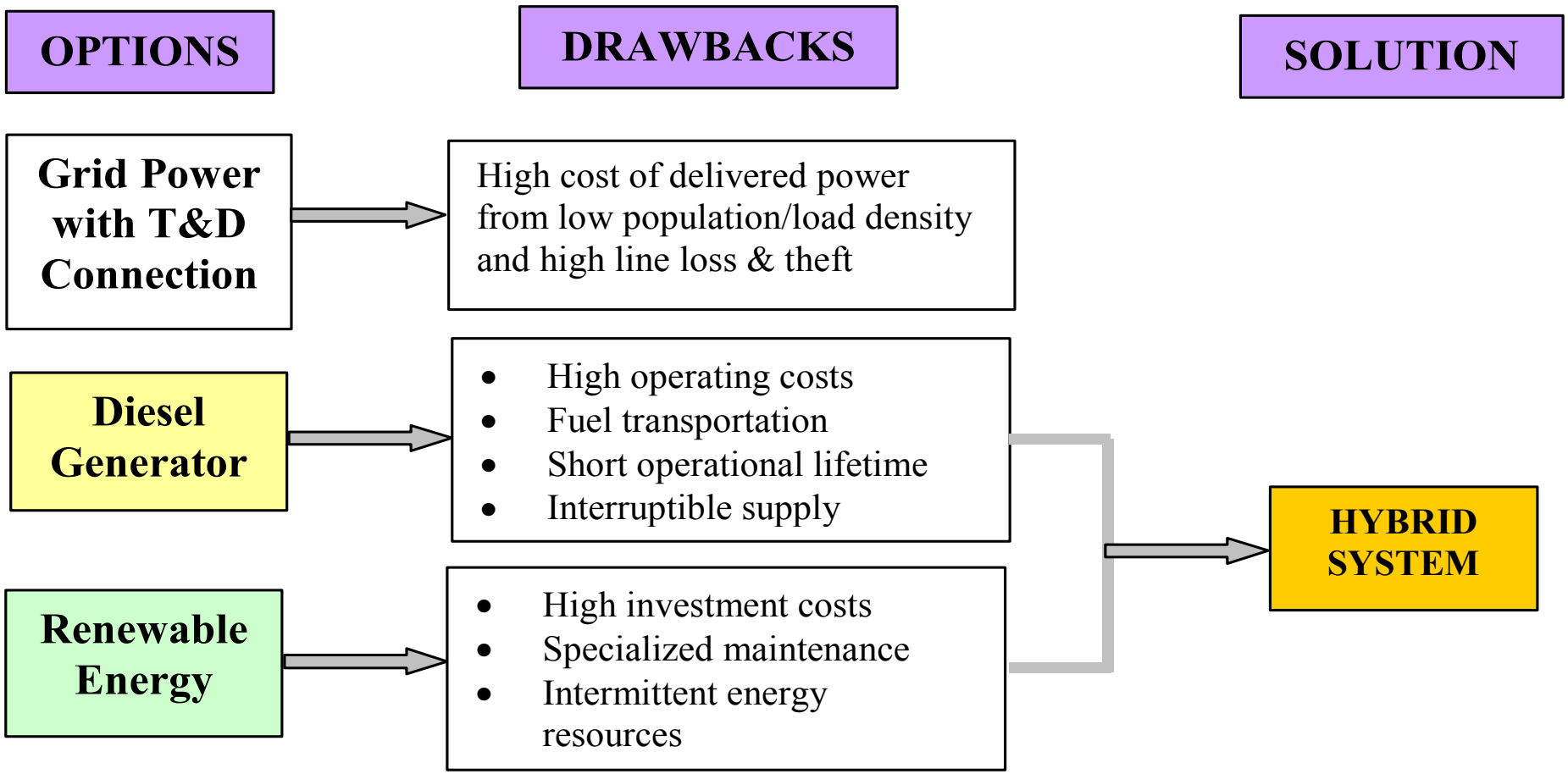
Period	Max Unrestricted Demand (MW)	Max Demand Catered (%)	Plant Load Factor (%)
April 01 - Jan 02	8476	80.4	67.3
April 02 - Jan 03	9040	85.7	69.8



An Alternative ADC Model

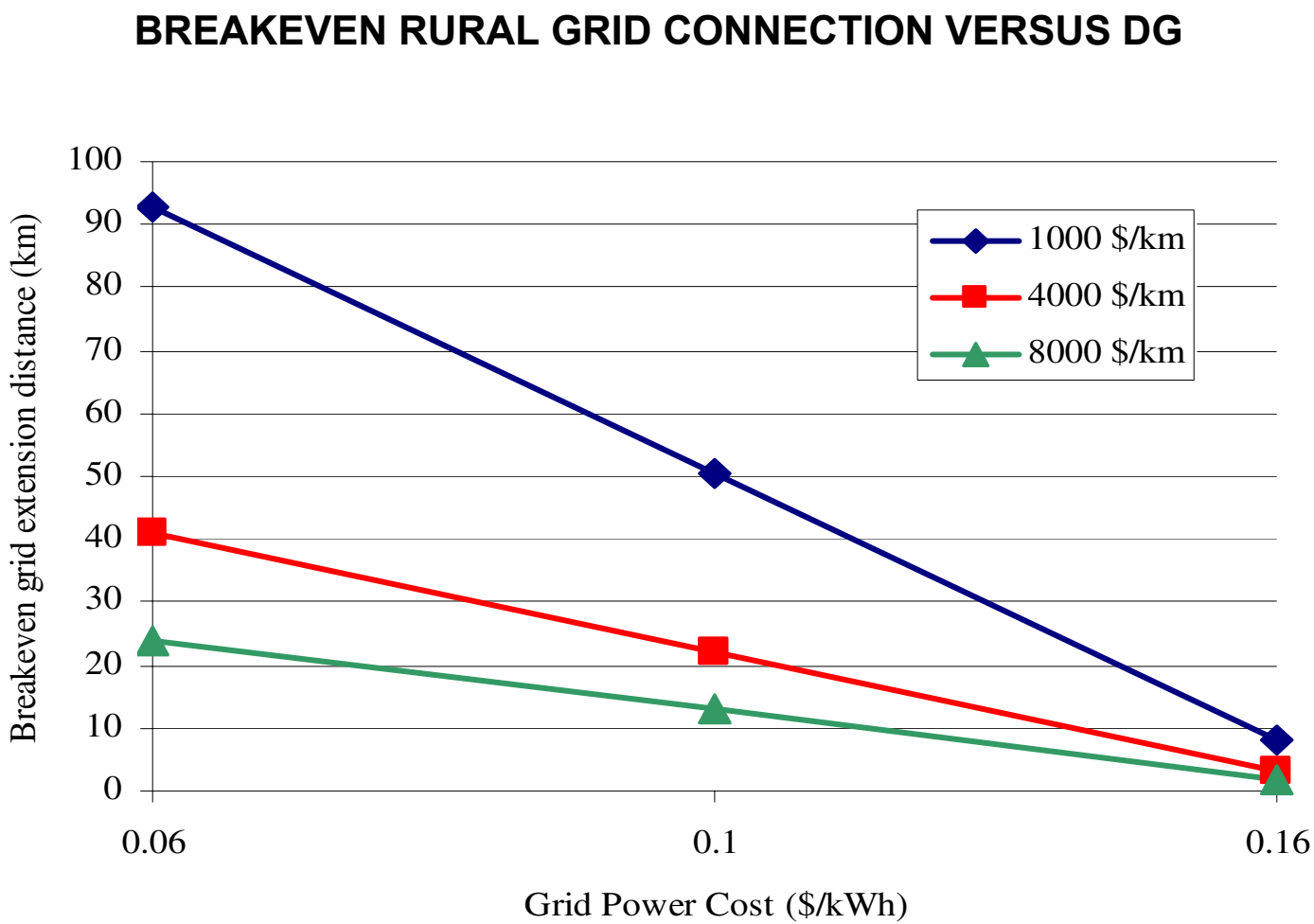
Model based analysis shows hybrid (wind-diesel) rural DG systems are economic…

RURAL DG SOLUTION



An Alternative ADC Model

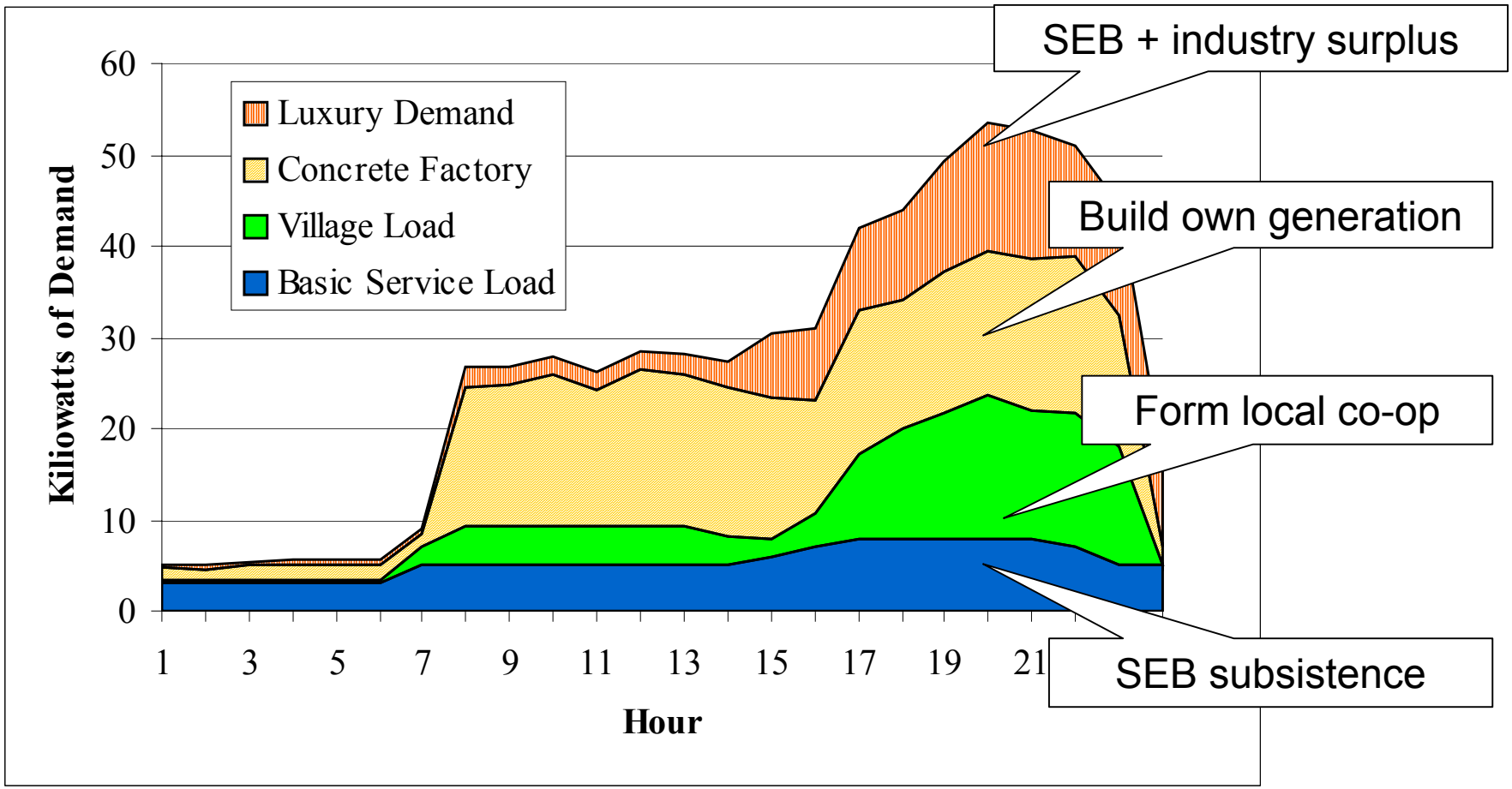
…. as T&D loses make grid connected power expensive especially in remote rural areas



An Alternative ADC Model

'Bottom-up' liberalisation provides new incentives and demand to be segmented….

POTENTIAL OUTCOME



An Alternative ADC Model

… but incumbent SEB and politicians will also have incentives to counteract

THE DEVILS IN THE DETAIL

- State governments and SERCs will implement - diverting federal government objective
- SEBs can thwart change using ‘technical’ issues – hindering access to grid
- SEB ‘electrification’ obligations reduced – slowing ‘rural’ versus ‘urban’ development
- Big rural loads can be ‘cherry-picked’ – making rural household load uneconomic
- Small rural loads (agriculture) has little incentive to invest as power is subsidised

CAREFUL ONGOING REGULATION AND LEGISLATION REQUIRED

Speaker

John Bower is a Senior Research Fellow at the Oxford Institute for Energy Studies which is an independent research charity affiliated to Oxford University and dedicated to advanced research in the social science aspects of energy. John joined OIES in November 2001 and his research interest is in the emergence and evolution of integrated cross-border electricity and gas markets. Specifically; the development of efficient pricing and investment mechanisms for energy, transmission capacity, and emissions.

Before joining the OIES, John completed his PhD at London Business School and his previous career was in the commodity industry. His experience ranges from energy trading, at Marc Rich & Co, to risk management consultancy, with Coopers & Lybrand, advising commodity traders, producers and processors in base metal, precious metal, 'softs' and energy markets. Immediately prior to his PhD he was Global Controller Metals/Commodities at Deutsche Morgan Grenfell.

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