PRESENT STATUS: ENERGY SUPPLIES, ENERGY CONSUMPTION, ENERGY DEFICIT IN PAKISTAN

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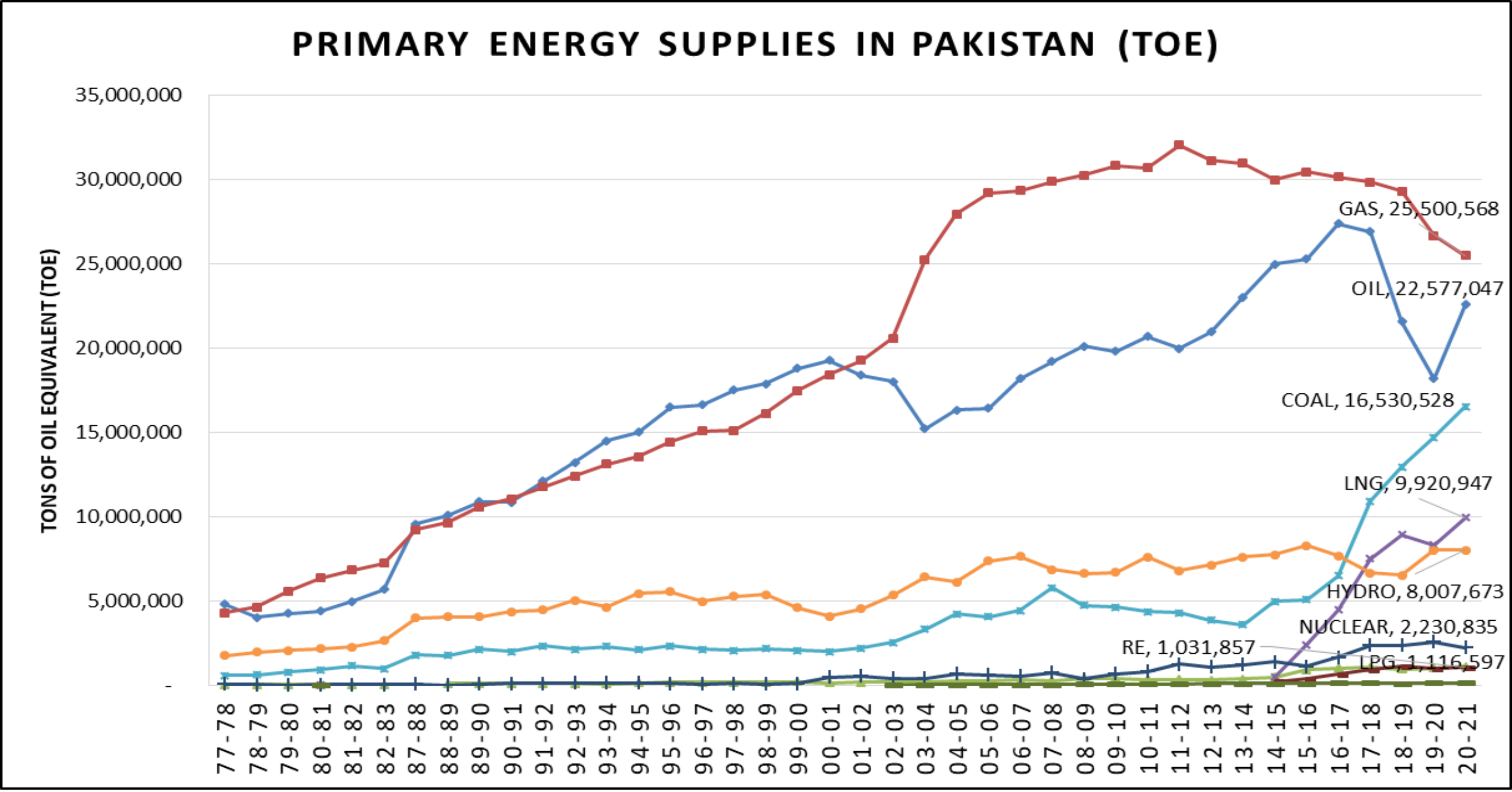
PAKISTAN ACADEMY OF ENGINEERING 26th SYMPOSIUM 17 DEC 2022

ENERGY CRISIS IN PAKISTAN

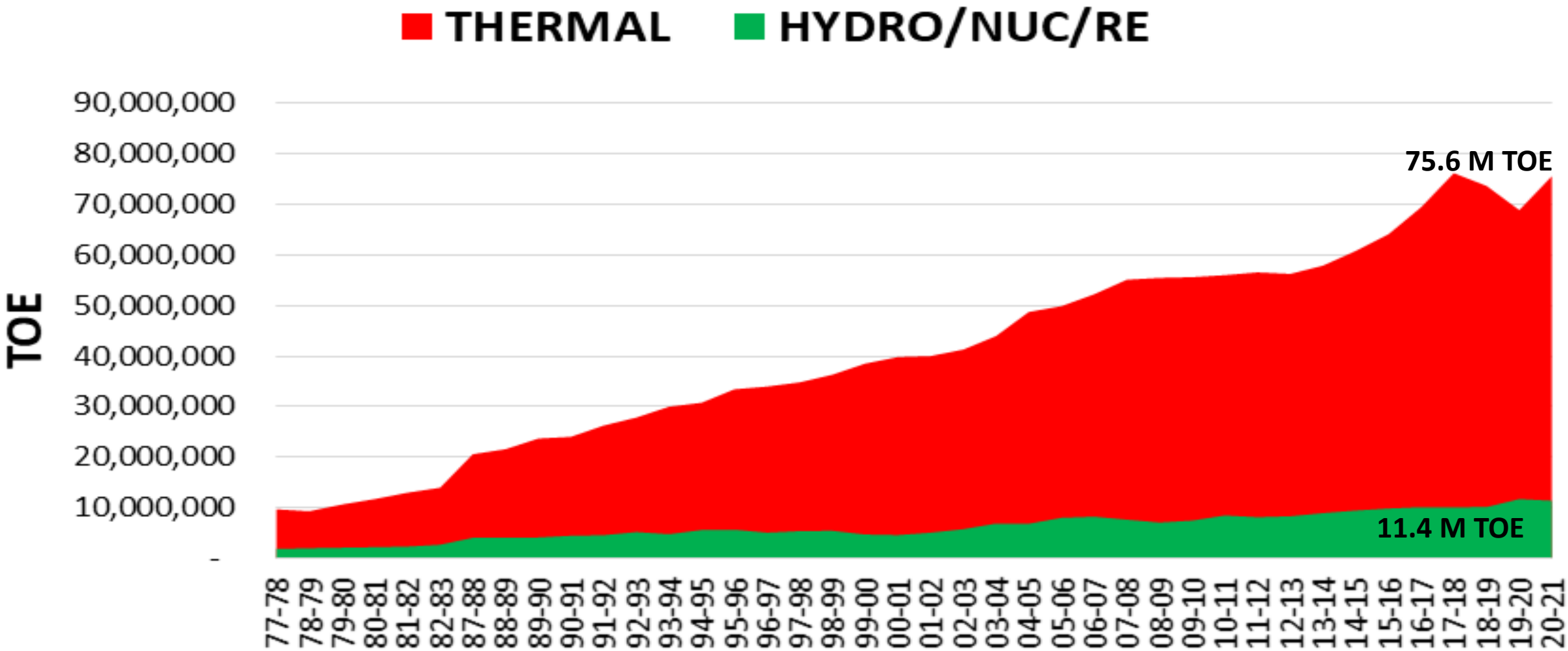
SEQUENCE

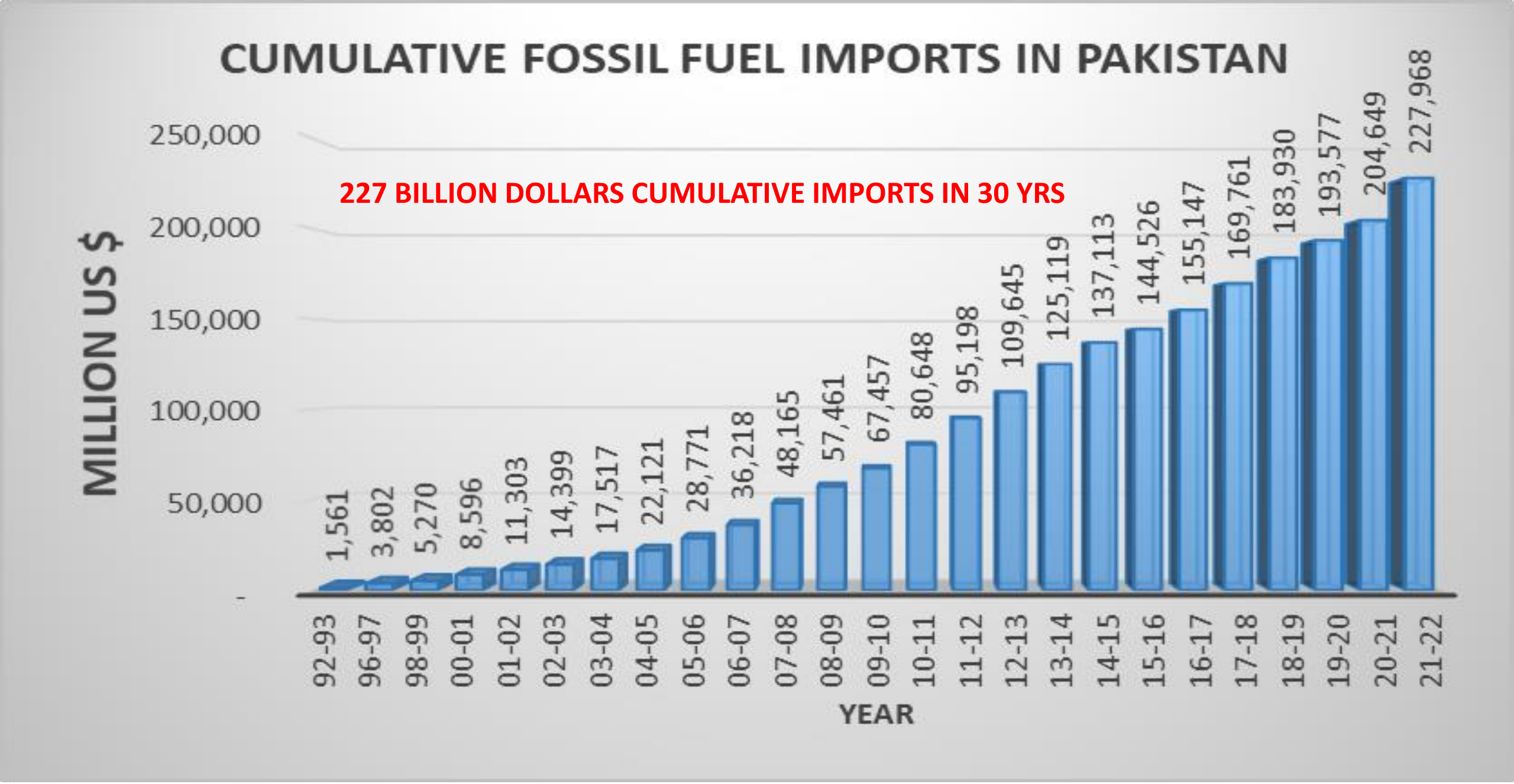
- PRIMARY ENERGY SUPPLIES----------
- NATURAL GAS, LPG & LNG RESERVES,PRODUCTION & IMPORTS----------
- CRUDE OIL RESERVES, PRODUCTION, REFINING AND IMPORTS ----------
- COAL RESERVES, PRODUCTION, AND IMPORTS ----------
- ELECTRICTY INSTALLED POWER AND GENERATION----------
- IMPACT OF EXECUTING IMPOSED IMPORTED IDEAS THAT CURBED PROGRESS OF A THRIVING NATIONAL ORGANIZATION ----------
- NUCLEAR ENERGY ----------
- RE ----------
- PROVINCIAL ELECTRICITY SCENARIO ----------
- CONCLUSION & RECOMMENDATIONS ----------

PRIMARY ENERGY SUPPLIES IN PAKISTAN (TOE)



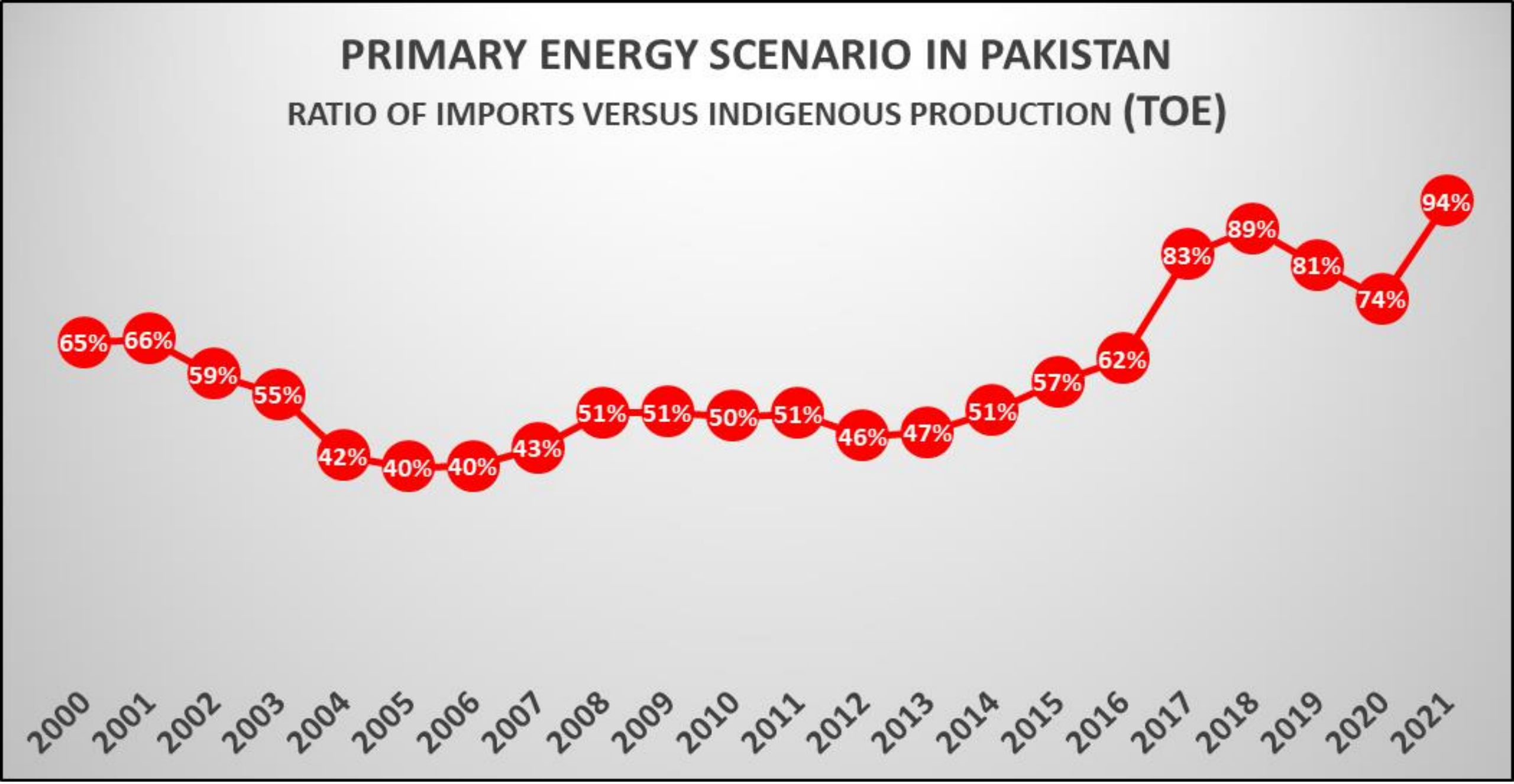
PATTERN OF PRIMARY ENERGY SUPPLIES
THERMAL VERSUS ALL OTHERS IN PAKISTAN



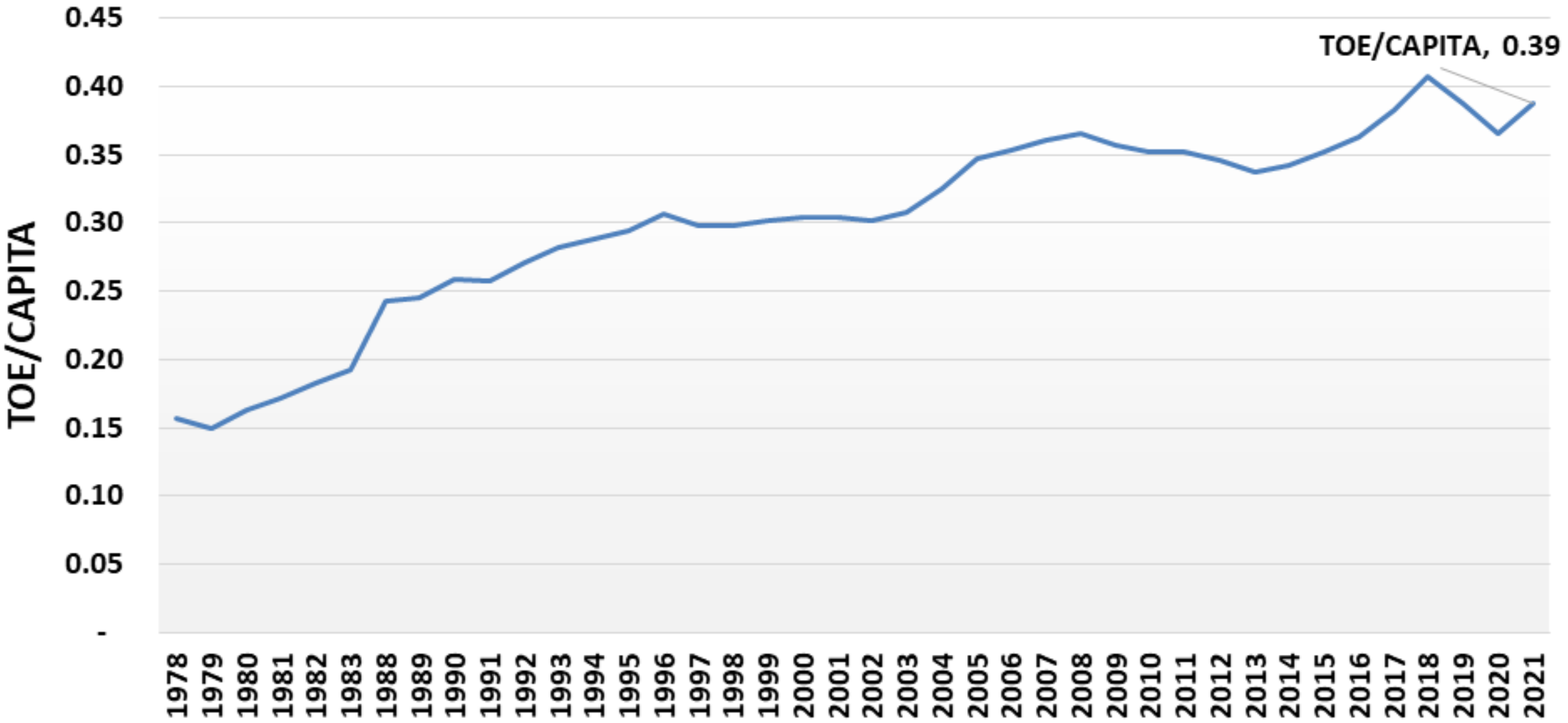

CUMULATIVE FOSSIL FUEL IMPORTS IN PAKISTAN
227 BILLION DOLLARS CUMULATIVE IMPORTS IN 30 YRS
MILLION US $
250,000
200,000
150,000
100,000
50,000
-
1,561
3,802
5,270
8,596
11,303
14,399
17,517
22,121
28,771
36,218
48,165
57,461
67,457
80,648
95,198
109,645
125,119
137,113
144,526
155,147
169,761
183,930
193,577
204,649
227,968
92-93
96-97
98-99
00-01
01-02
02-03
03-04
04-05
05-06
06-07
07-08
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
YEAR

PRIMARY ENERGY SCENARIO IN PAKISTAN

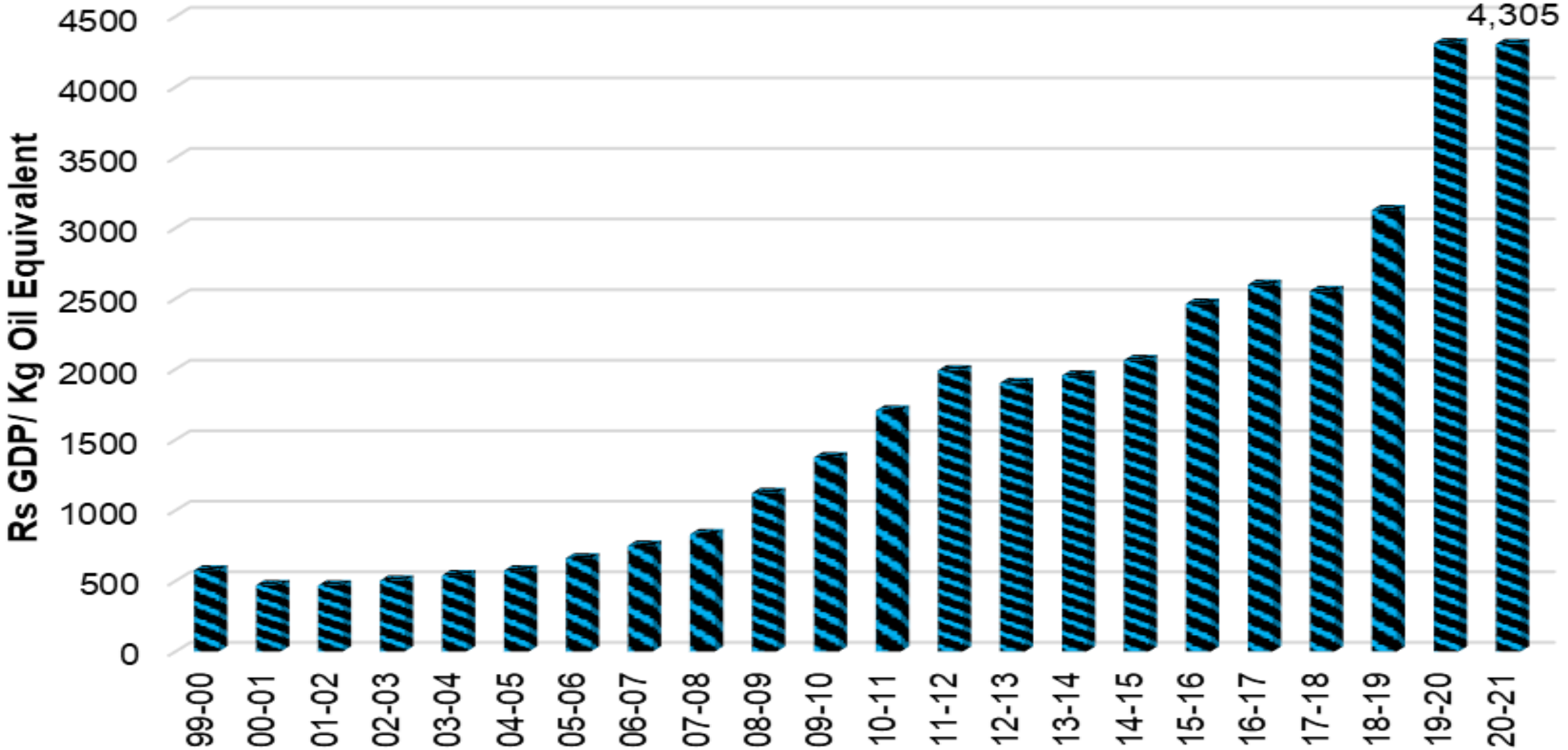
RATIO OF IMPORTS VERSUS INDIGENOUS PRODUCTION (TOE)



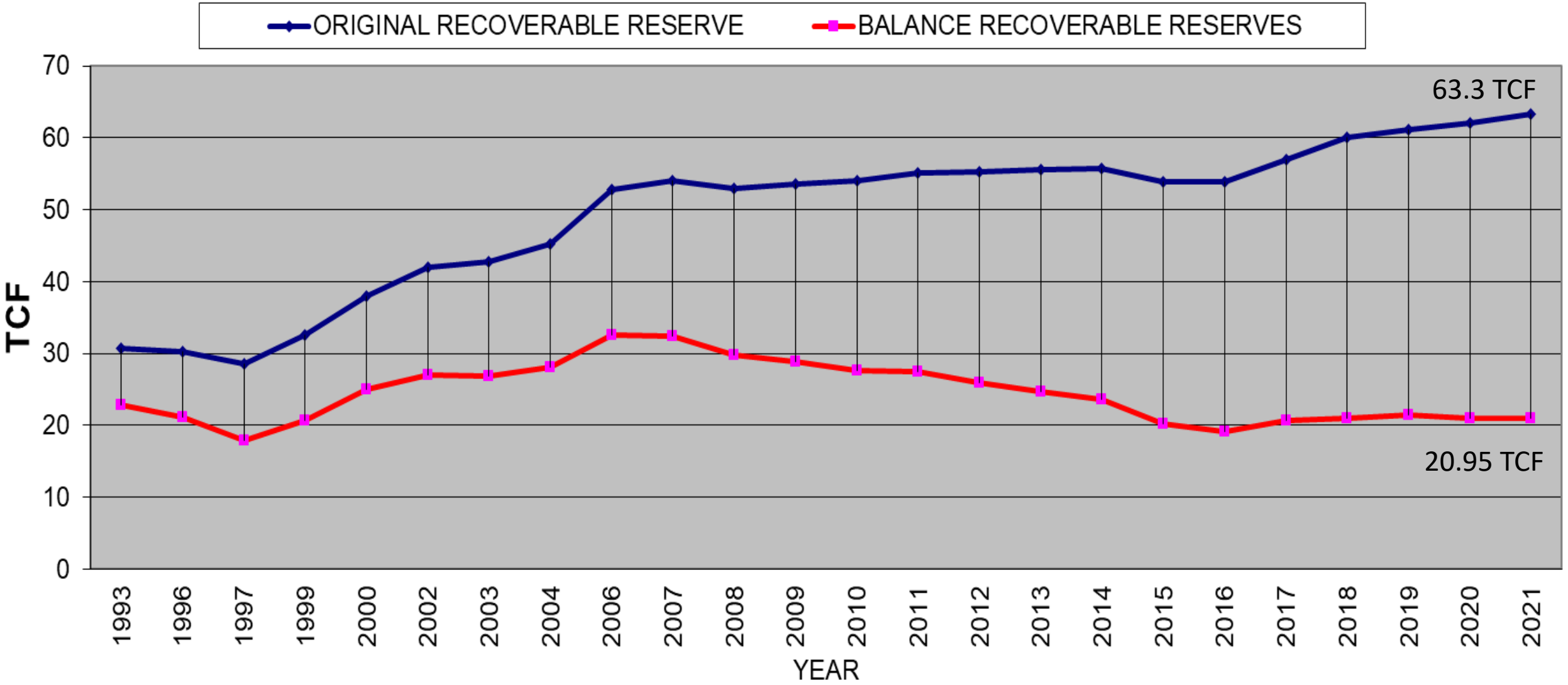
PRIMARY ENERGY CONSUMPTION PER CAPITA IN PAKISTAN



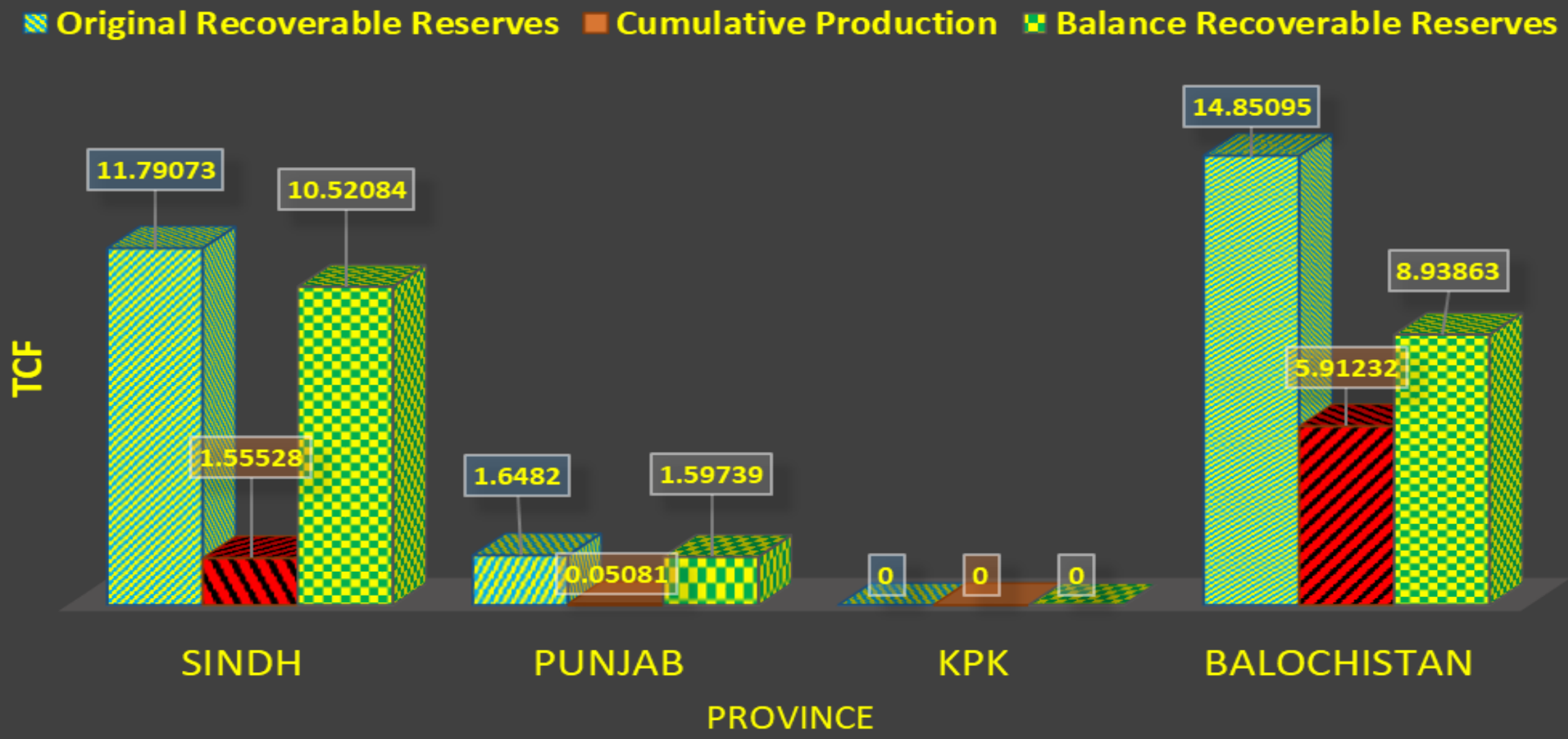
ENERGY INTENSITY IN PAKISTAN

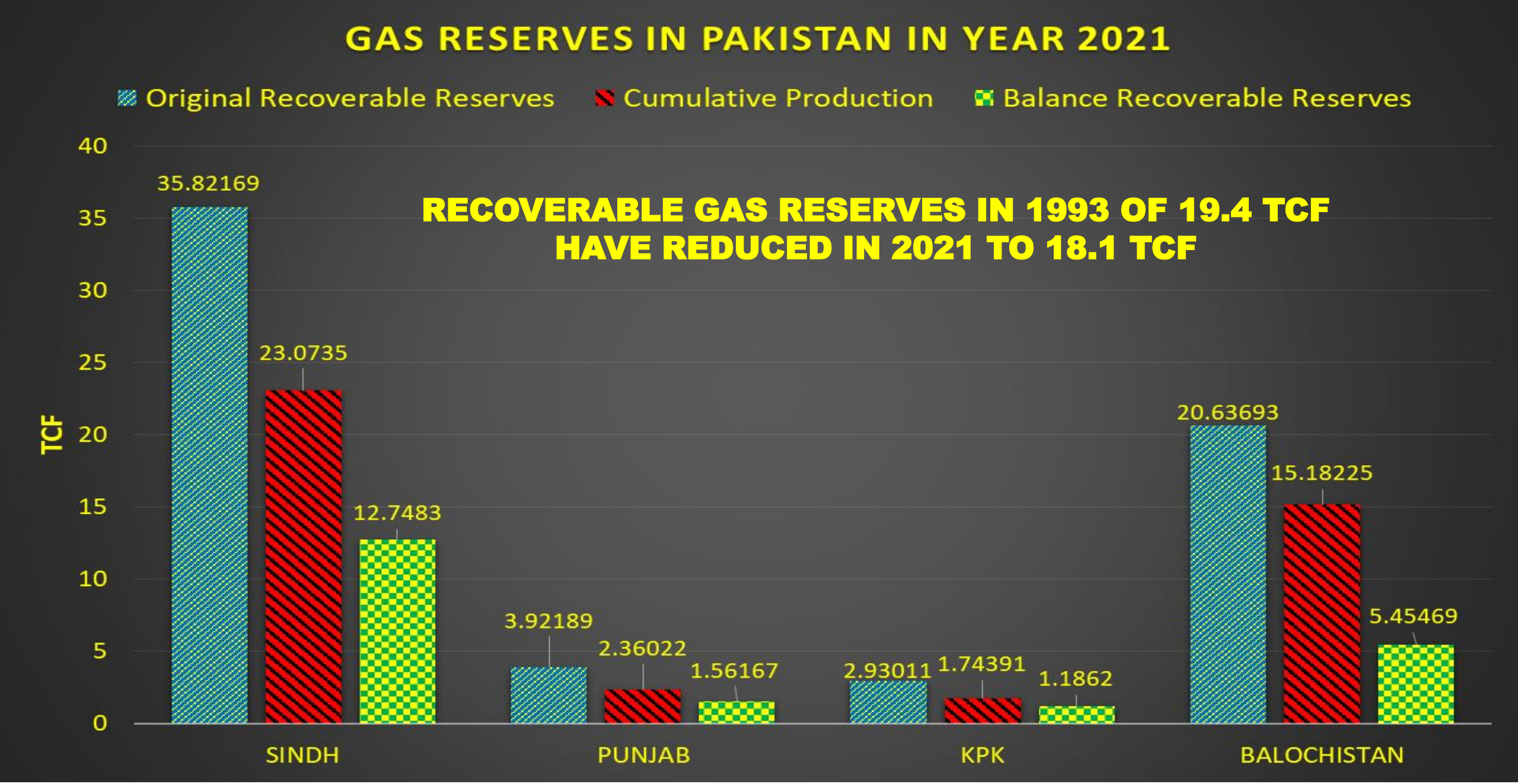


ORIGINAL NATURAL GAS RESERVES VERSUS BALANCE RECOVERABLE GAS RESERVES

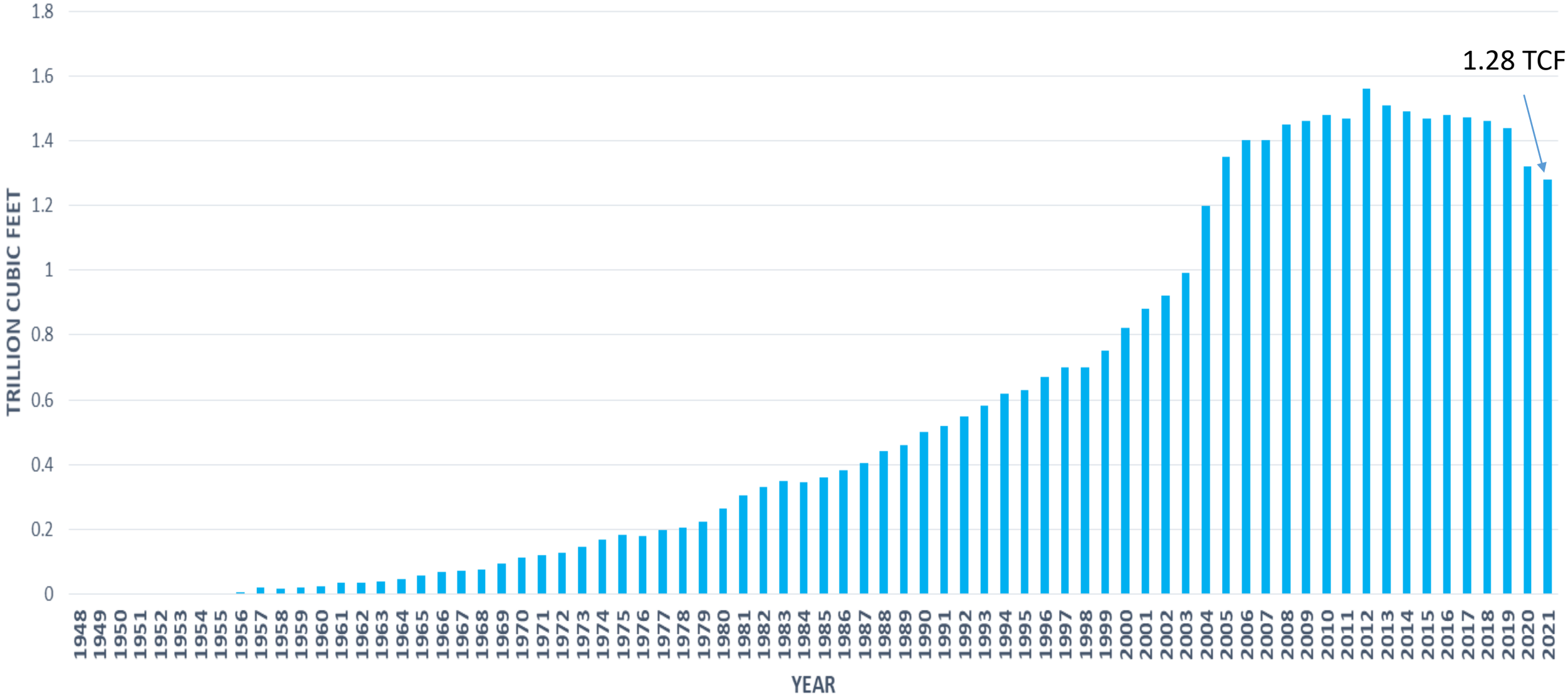


GAS RESERVES IN PAKISTAN IN YEAR 1993

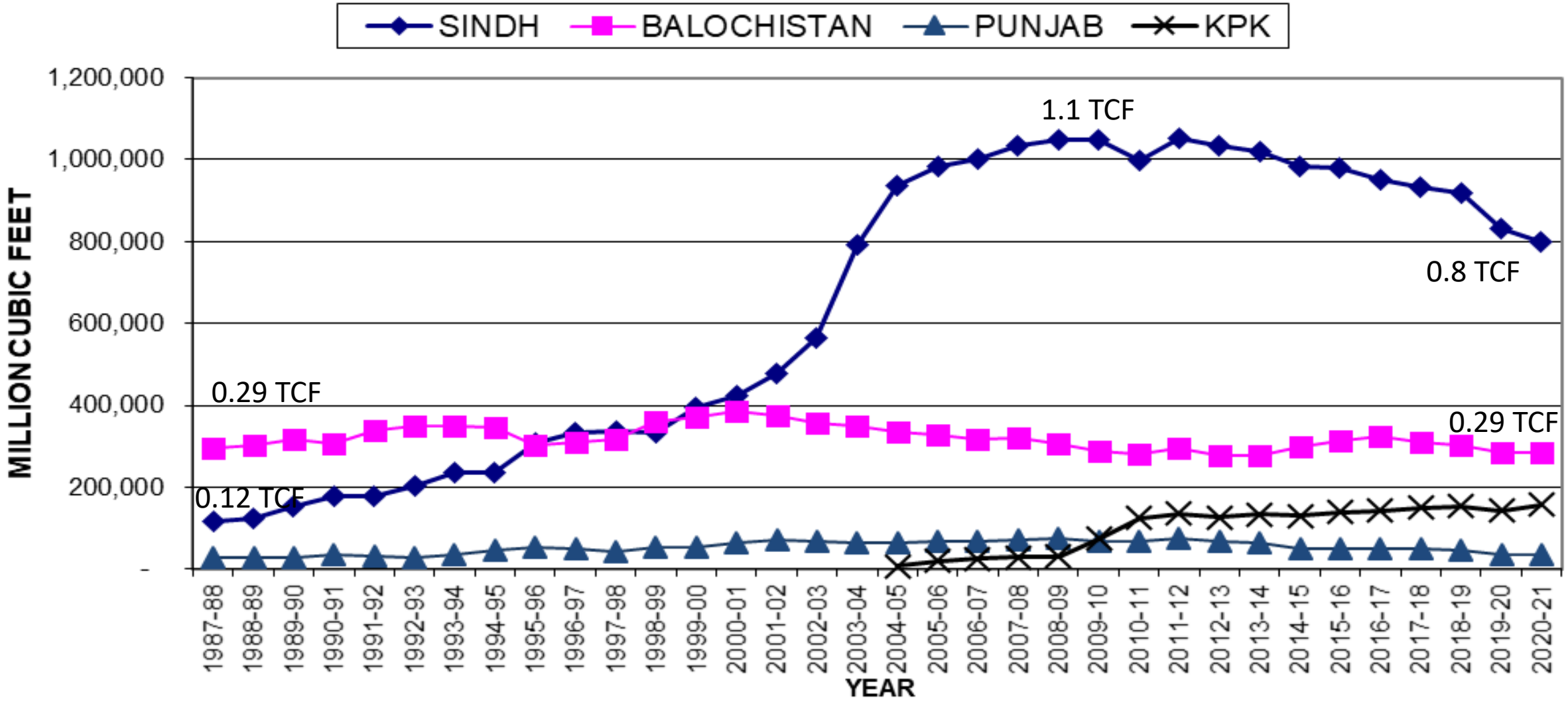



GAS RESERVES IN PAKISTAN IN YEAR 2021
Original Recoverable Reserves
Cumulative Production
Balance Recoverable Reserves
RECOVERABLE GAS RESERVES IN 1993 OF 19.4 TCF
HAVE REDUCED IN 2021 TO 18.1 TCF
TCF
40
35
30
25
20
15
10
5
0
35.82169
23.0735
12.7483
3.92189
2.36022
1.56167
2.93011
1.74391
1.1862
20.63693
15.18225
5.45469
SINDH
PUNJAB
KPK
BALOCHISTAN

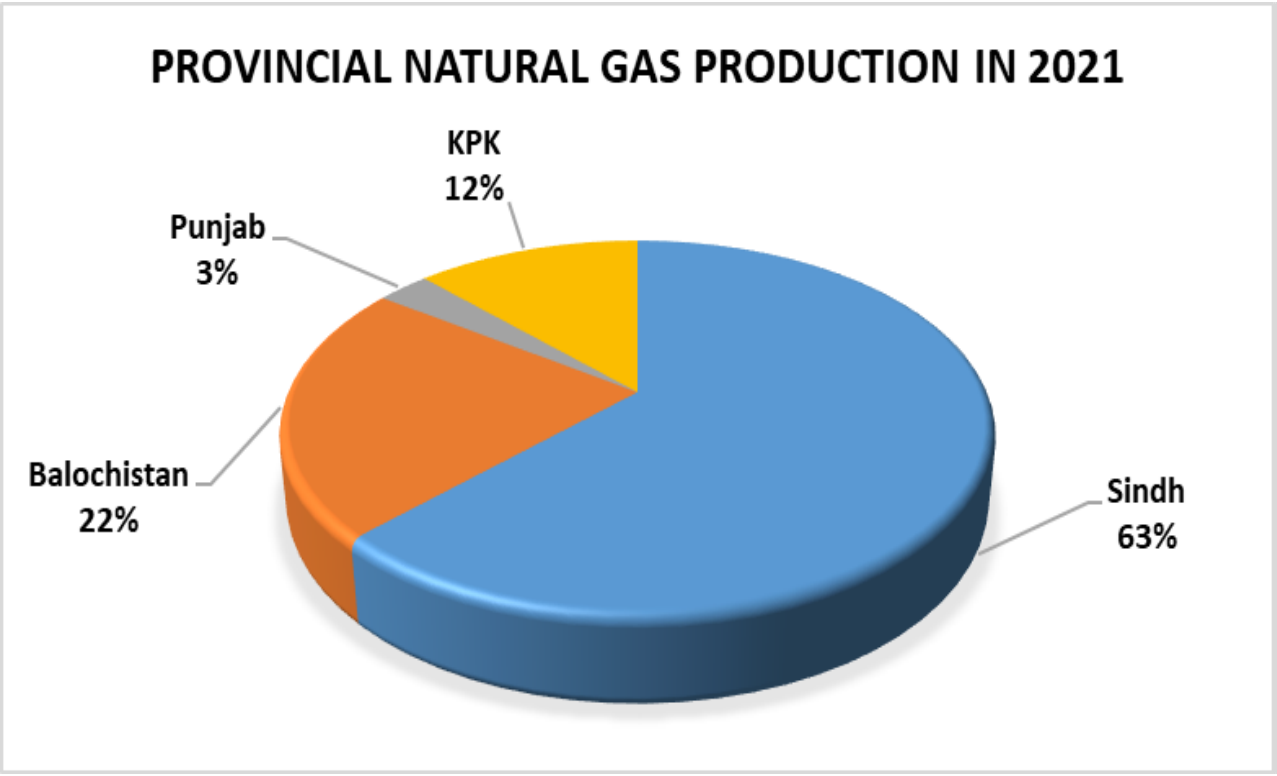
PATTERN OF ANNUAL PRODUCTION OF NATURAL GAS IN PAKISTAN



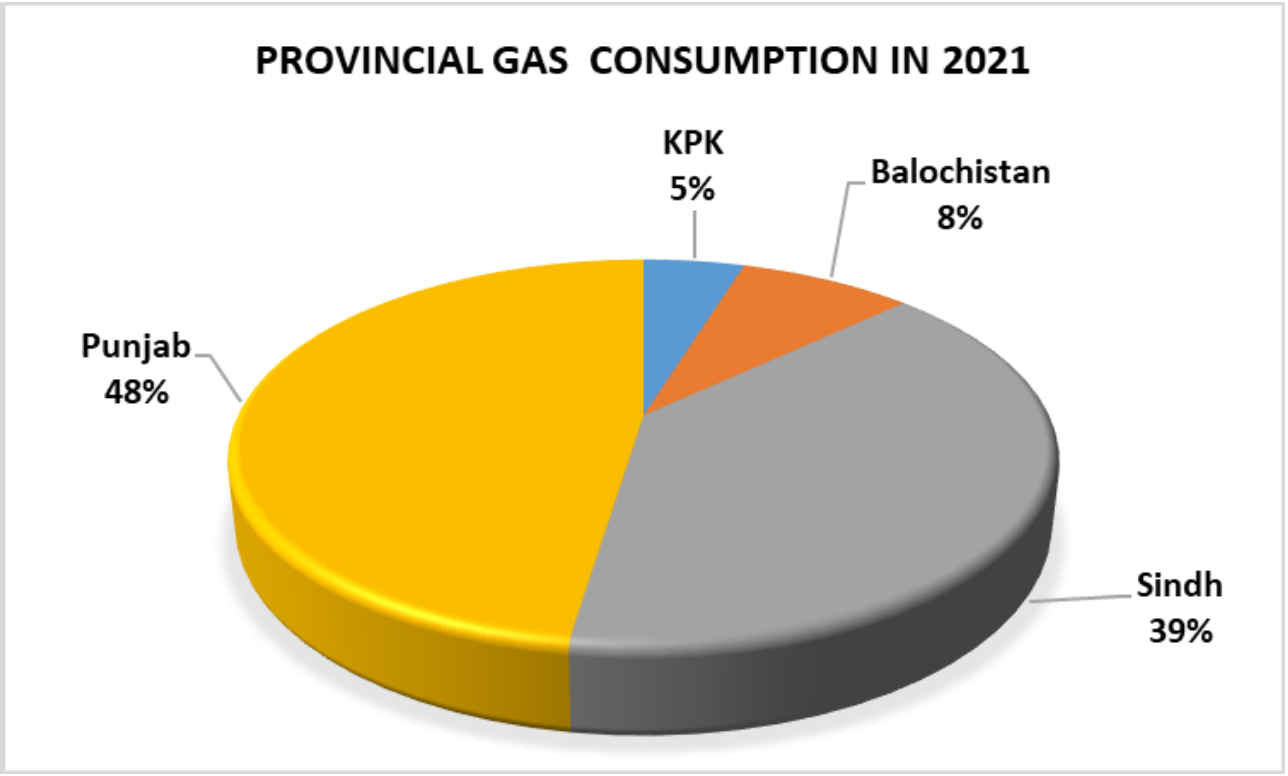
NATURAL GAS PRODUCTION IN PAKISTAN



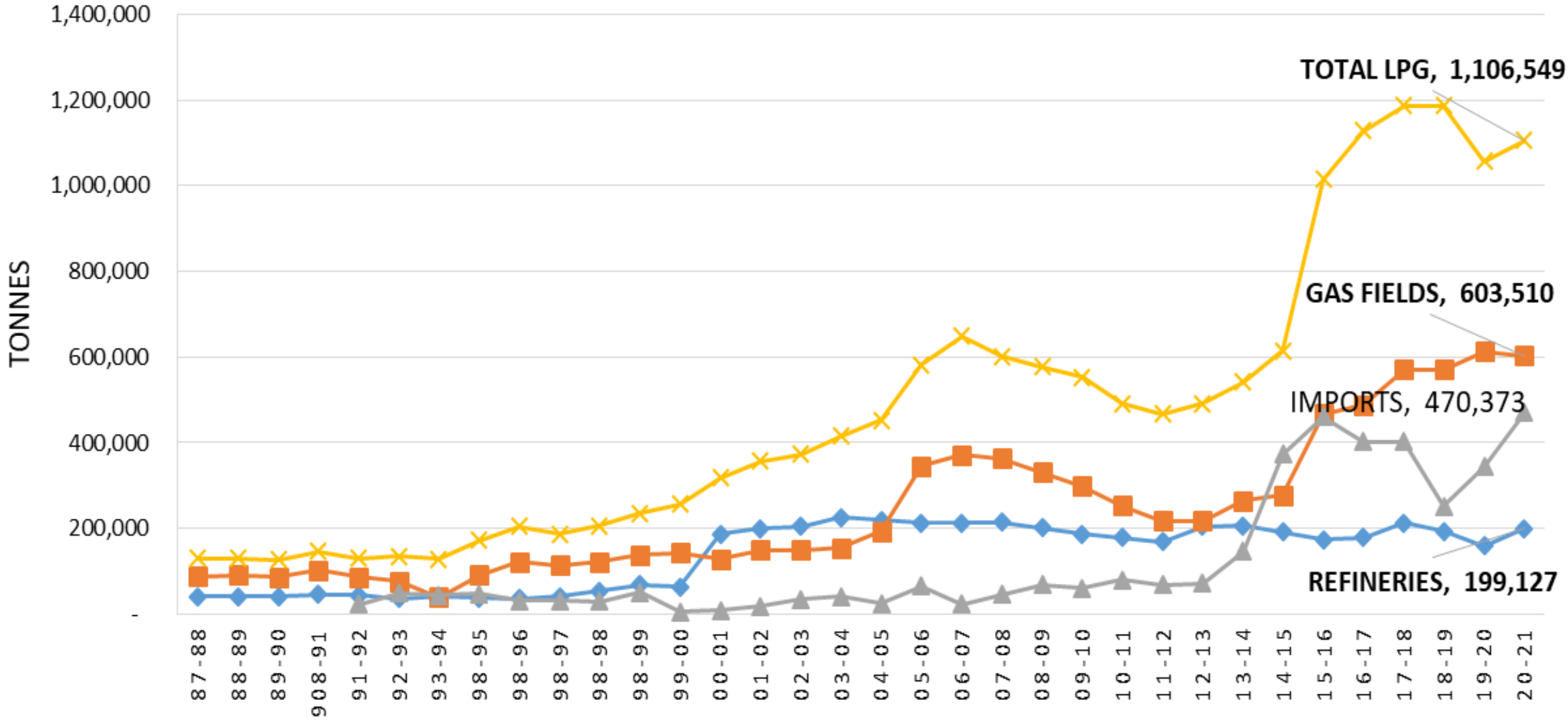
GAS PRODUCTION

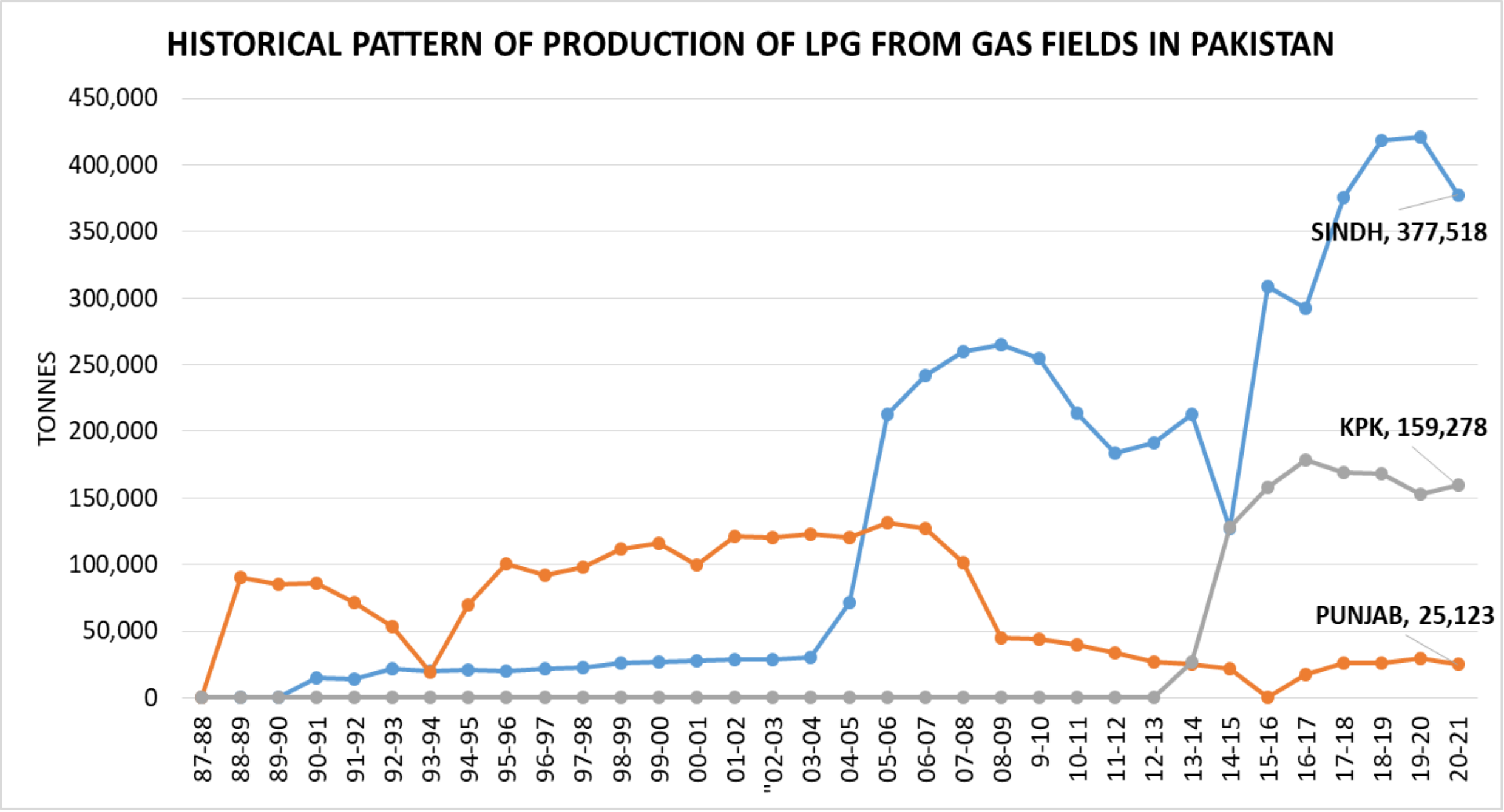


GAS CONSUMPTION

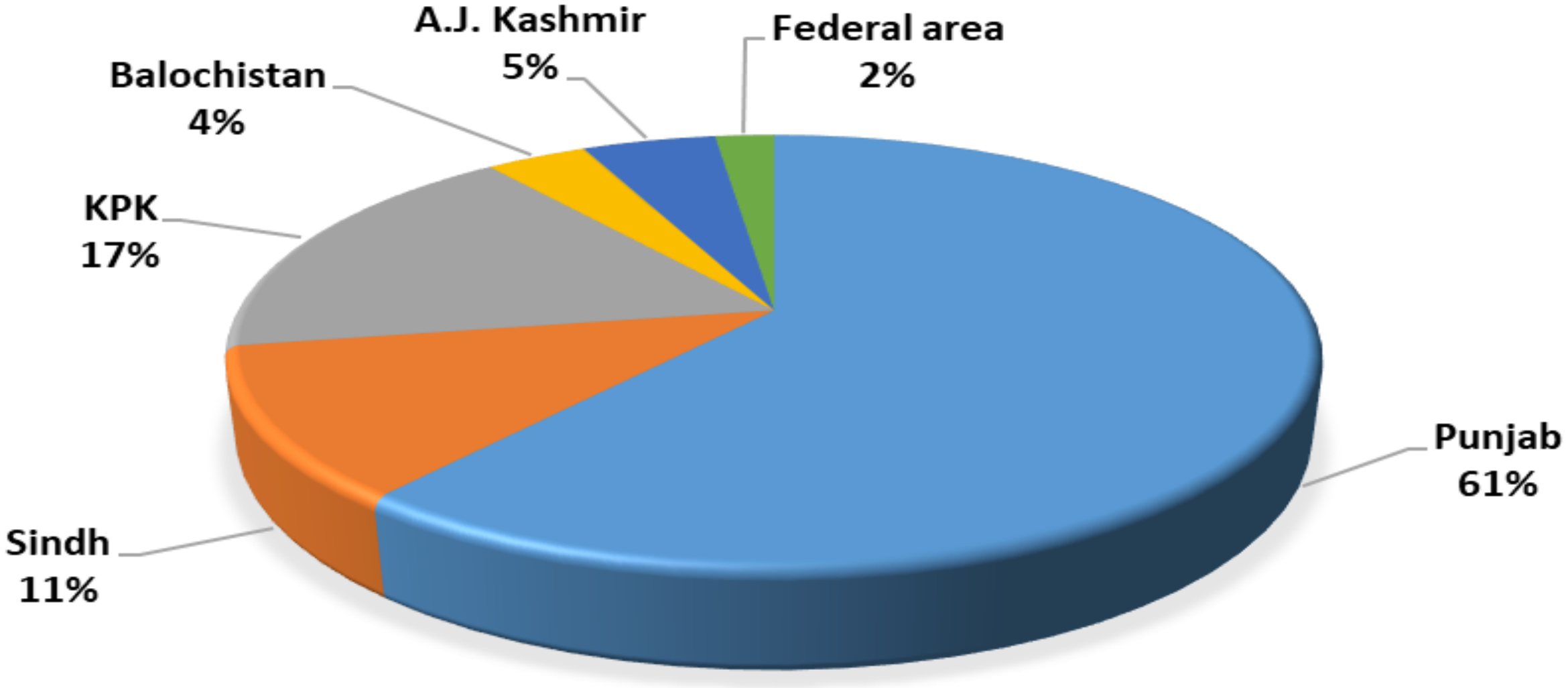


PATTERN OF LPG PRODUCTION & IMPORTS IN PAKISTAN

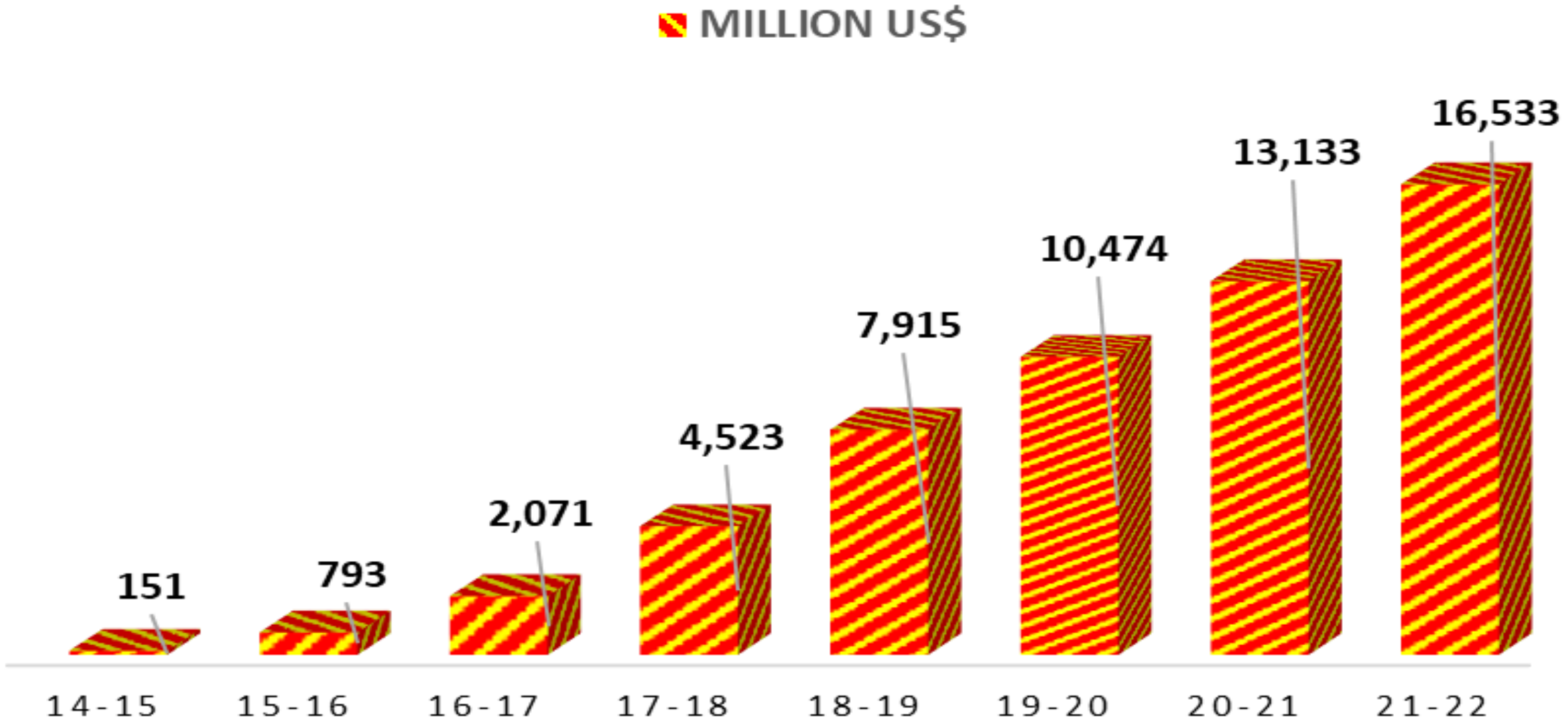



HISTORICAL PATTERN OF PRODUCTION OF LPG FROM GAS FIELDS IN PAKISTAN
TONNES
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
SINDH, 377,518
KPK, 159,278
PUNJAB, 25,123
87-88
88-89
89-90
90-91
91-92
92-93
93-94
94-95
95-96
96-97
97-98
98-99
99-00
00-01
01-02
"02-03
03-04
04-05
05-06
06-07
07-08
08-09
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21

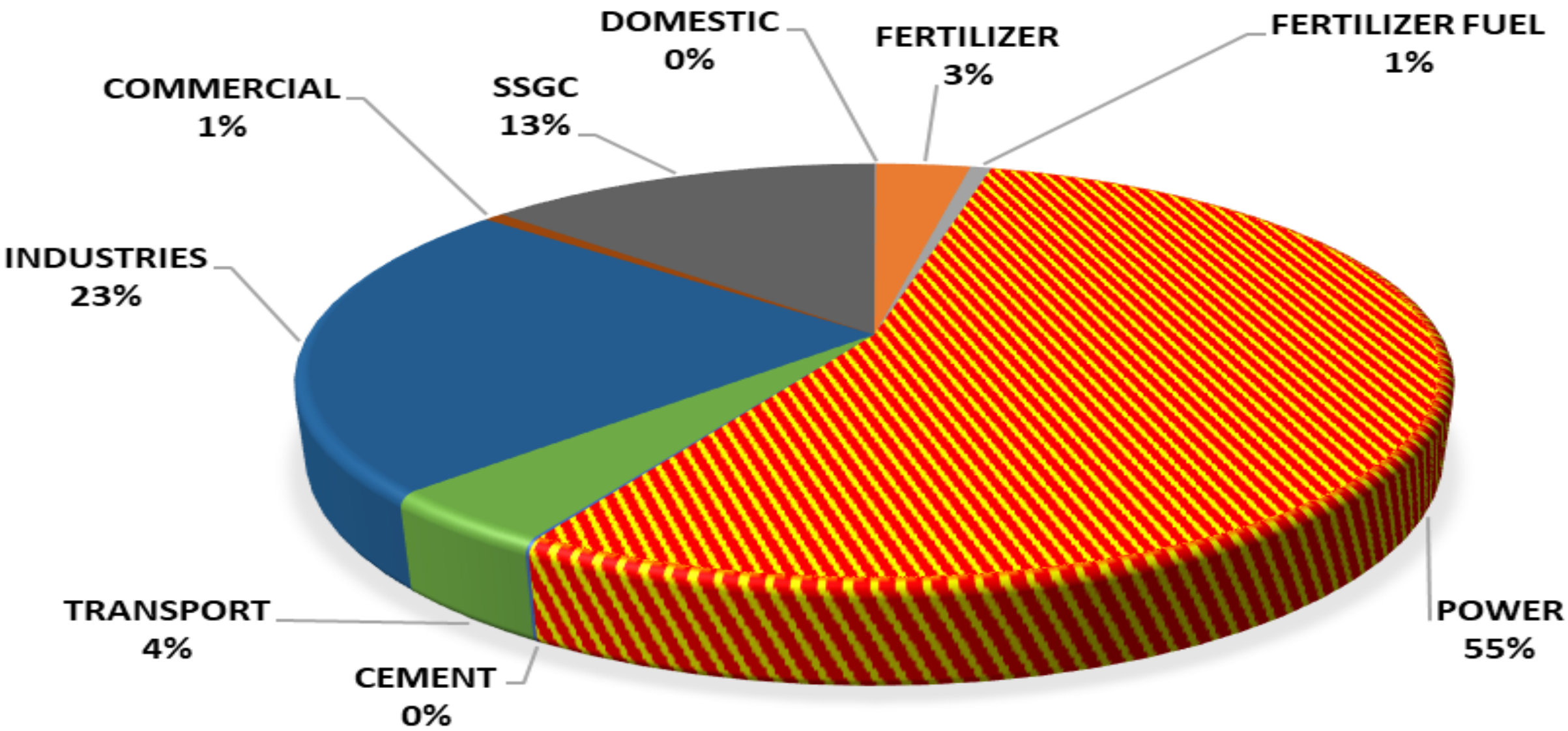
LPG CONSUMPTION BY REGION (2020-21)

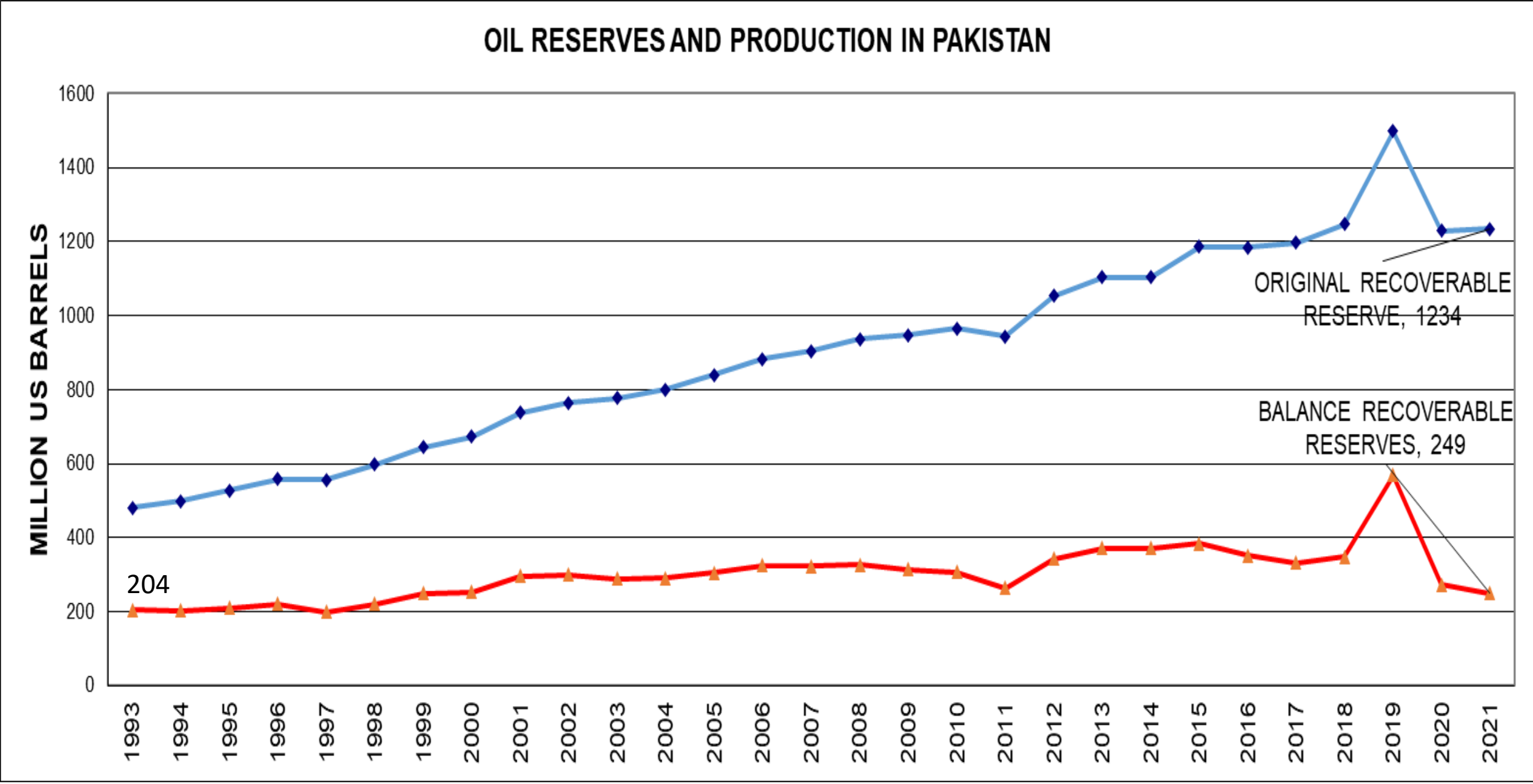


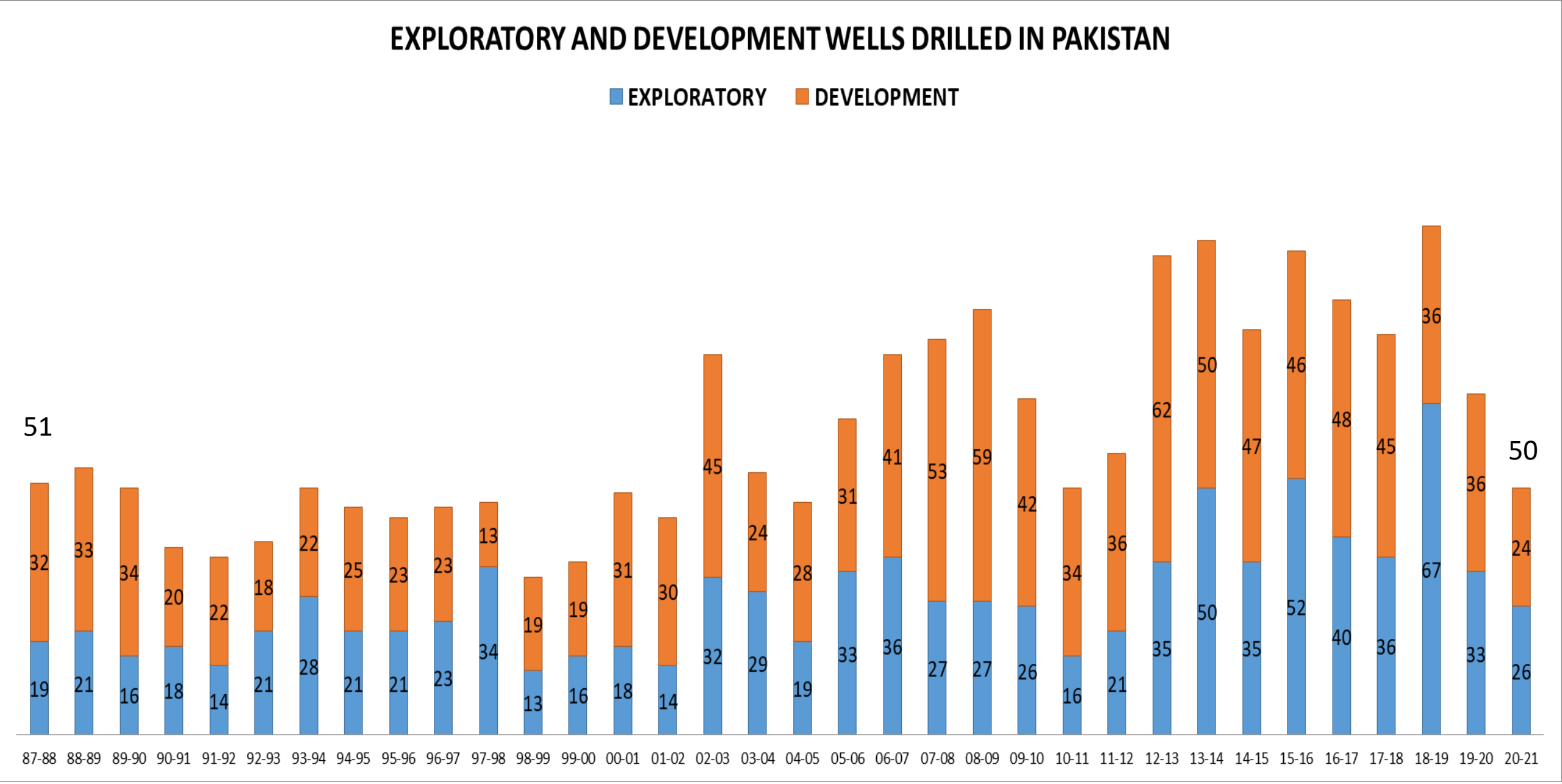
CUMULATIVE EXPENDITURE ON IMPORT OF LNG IN SEVEN YEARS IN PAKISTAN



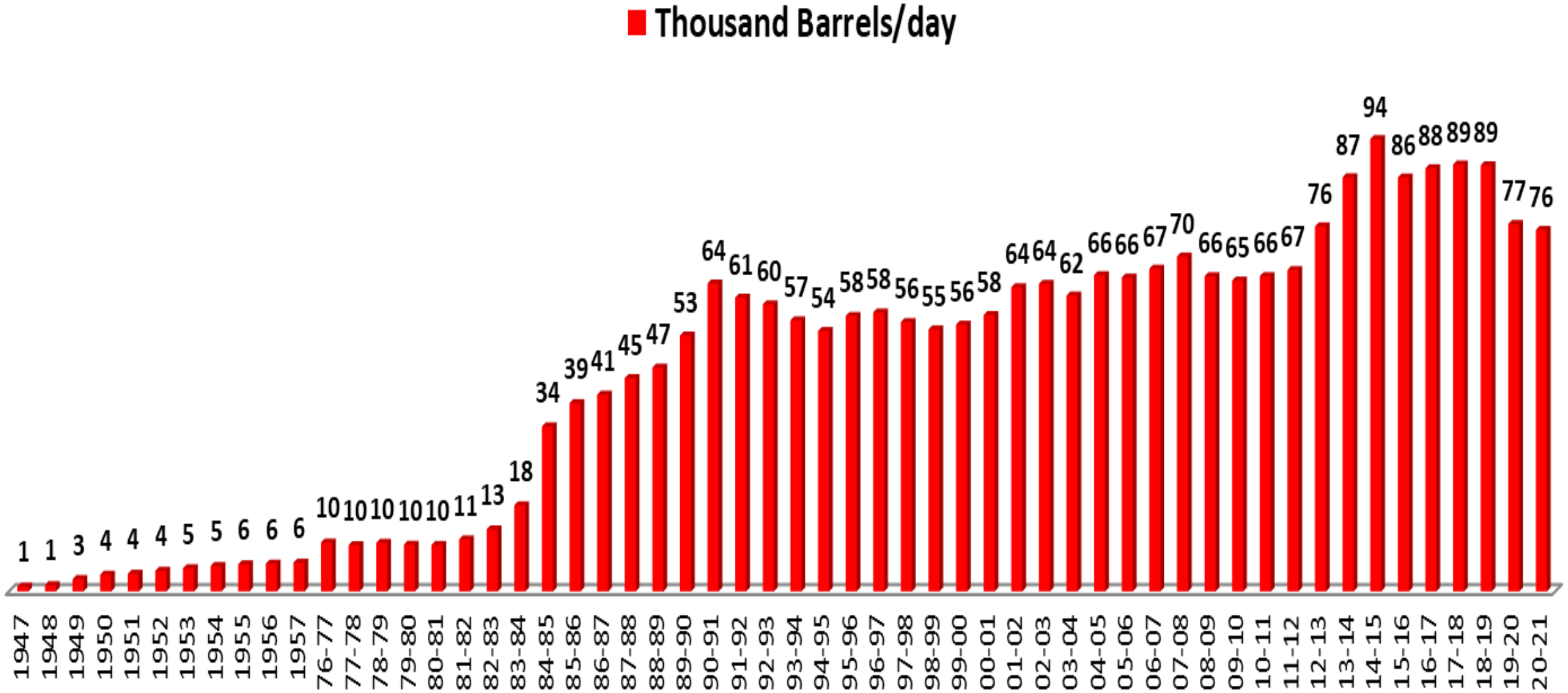
LNG CONSUMPTION PATTERN

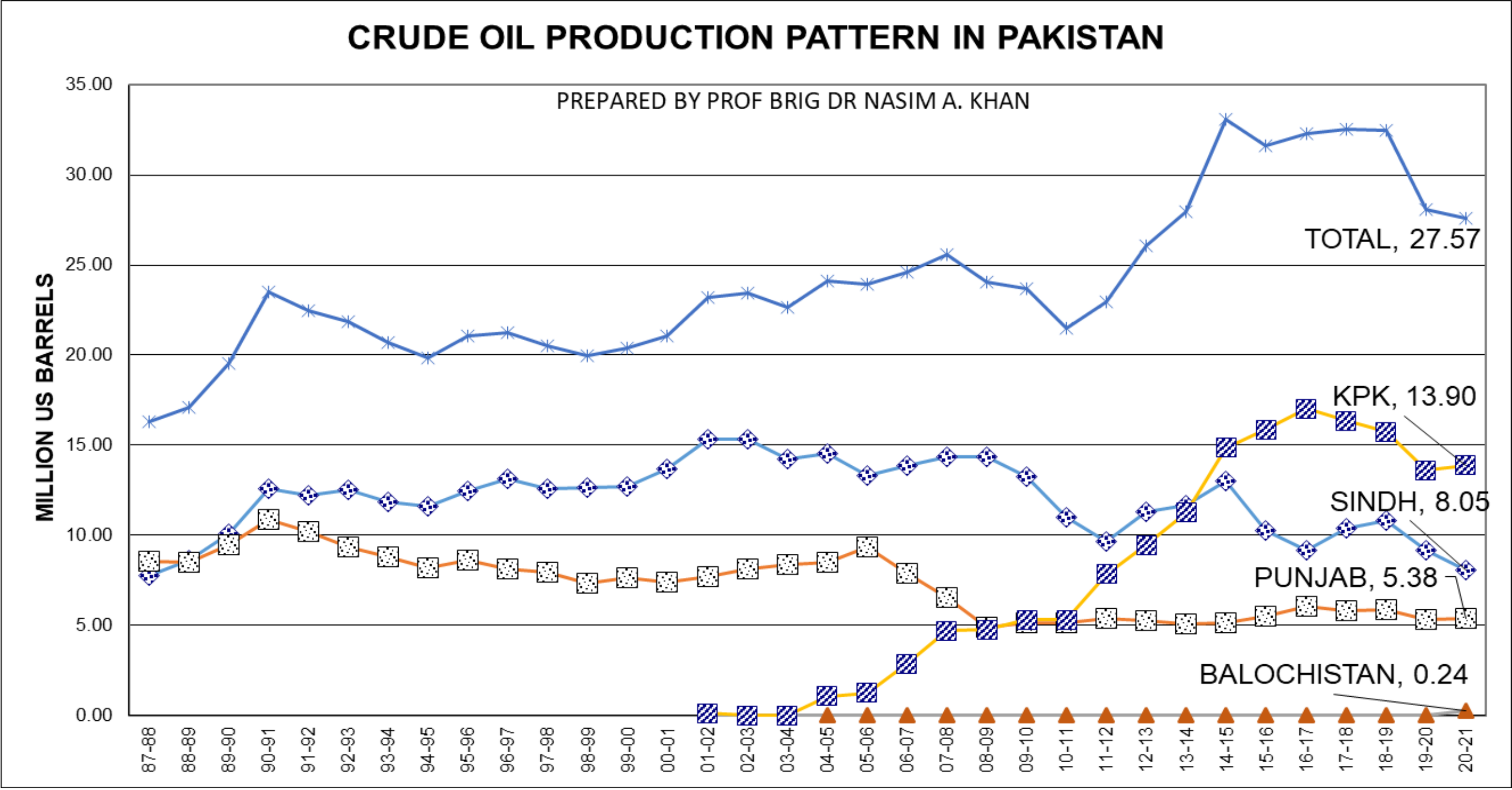



OIL RESERVES AND PRODUCTION IN PAKISTAN
MILLION US BARRELS
1600
1400
1200
1000
800
600
400
200
0
ORIGINAL RECOVERABLE RESERVE, 1234
BALANCE RECOVERABLE RESERVES, 249
204
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021


EXPLORATORY AND DEVELOPMENT WELLS DRILLED IN PAKISTAN
EXPLORATORY
DEVELOPMENT
51
50
87-88 88-89 89-90 90-91 91-92 92-93 93-94 94-95 95-96 96-97 97-98 98-99 99-00 00-01 01-02 02-03 03-04 04-05 05-06 06-07 07-08 08-09 09-10 10-11 11-12 12-13 13-14 14-15 15-16 16-17 17-18 18-19 19-20 20-21
19 21 16 18 14 21 28 21 21 23 34 13 16 18 14 32 29 19 33 36 27 27 26 16 21 35 50 35 52 40 36 67 33 26
32 33 34 20 22 18 22 25 23 23 13 19 19 31 30 45 24 28 31 41 53 59 42 34 36 62 50 47 46 48 45 36 36 24

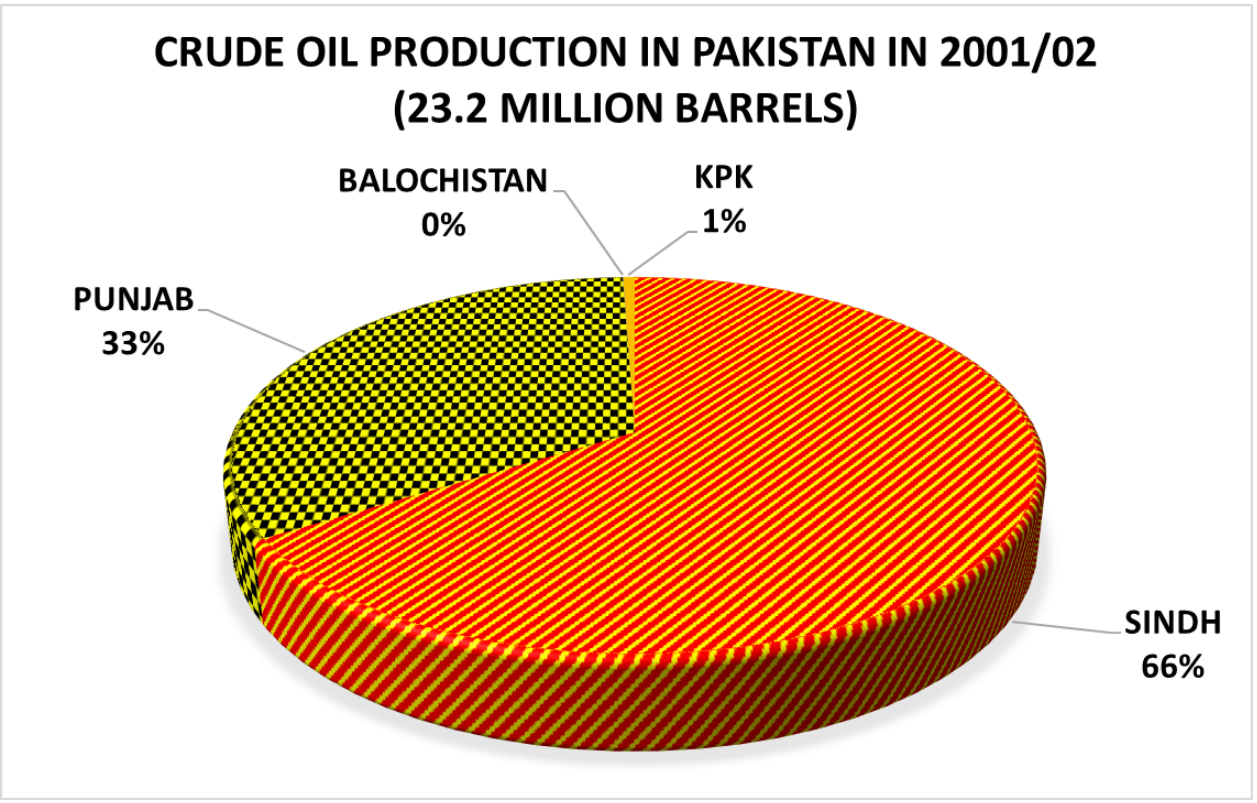
DAILY PRODUCTION OF CRUDE OIL IN PAKISTAN



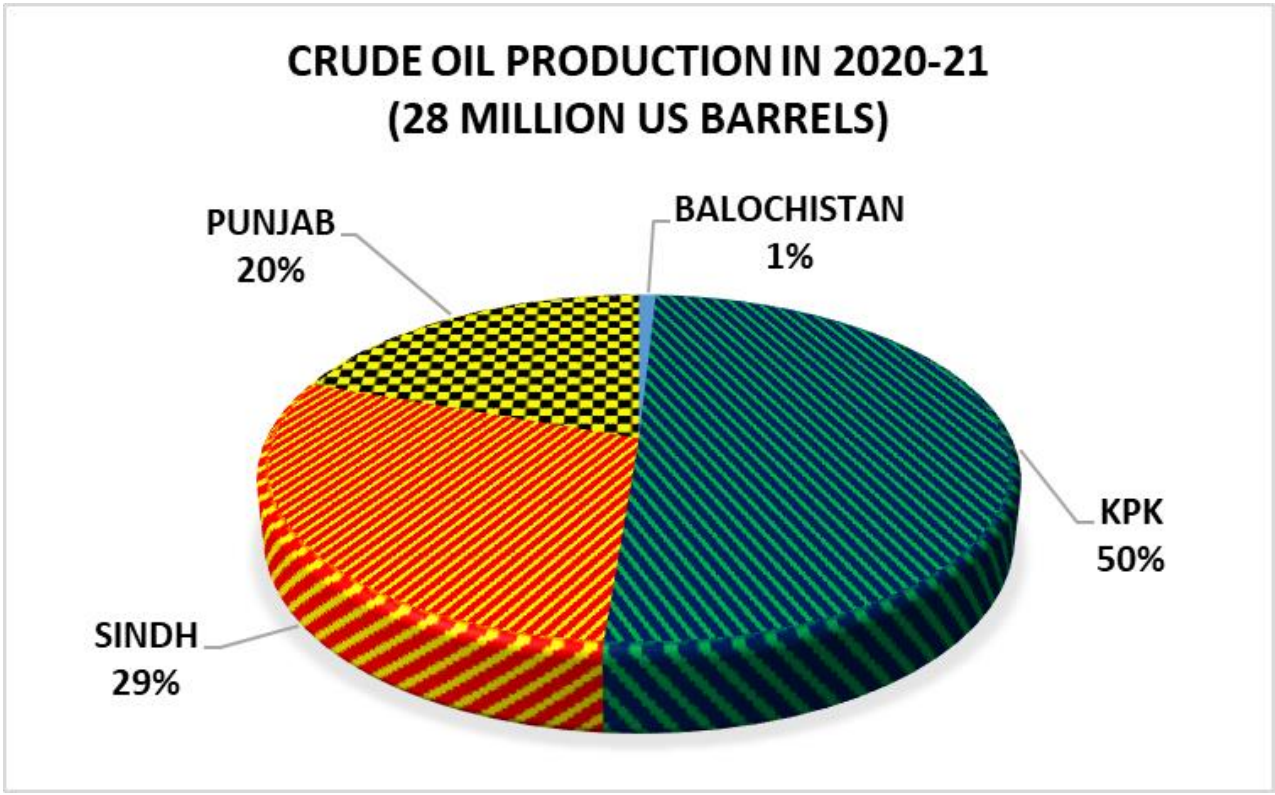

CRUDE OIL PRODUCTION PATTERN IN PAKISTAN
PREPARED BY PROF BRIG DR NASIM A. KHAN
MILLION US BARRELS
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
TOTAL, 27.57
KPK, 13.90
SINDH, 8.05
PUNJAB, 5.38
BALOCHISTAN, 0.24
87-88
88-89
89-90
90-91
91-92
92-93
93-94
94-95
95-96
96-97
97-98
98-99
99-00
00-01
01-02
02-03
03-04
04-05
05-06
06-07
07-08
08-09
09-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21

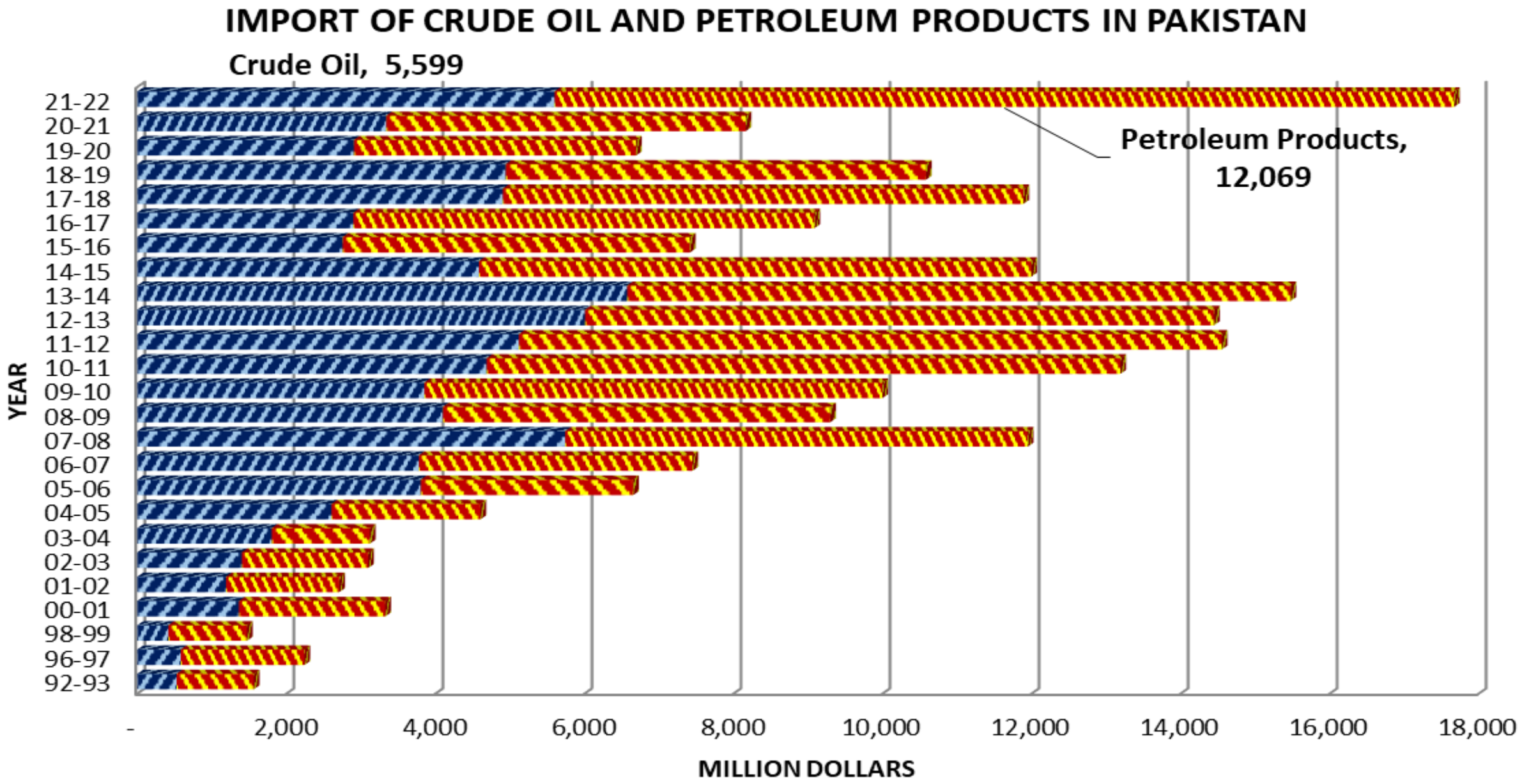
SHIFT IN CRUDE OIL PRODUCTION BETWEEN PROVINCES IN 20 YEARS

YEAR 2001

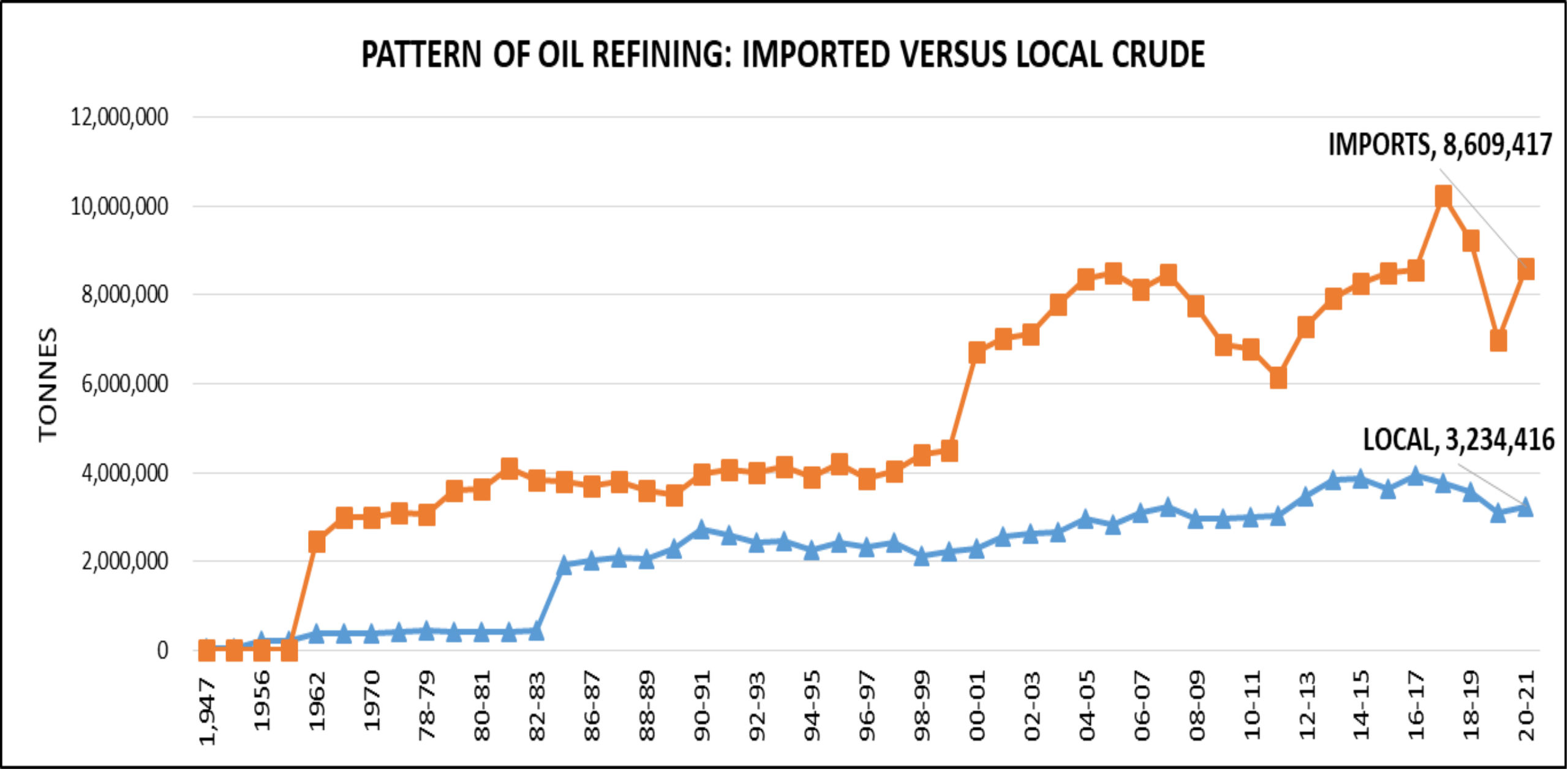


YEAR 2021

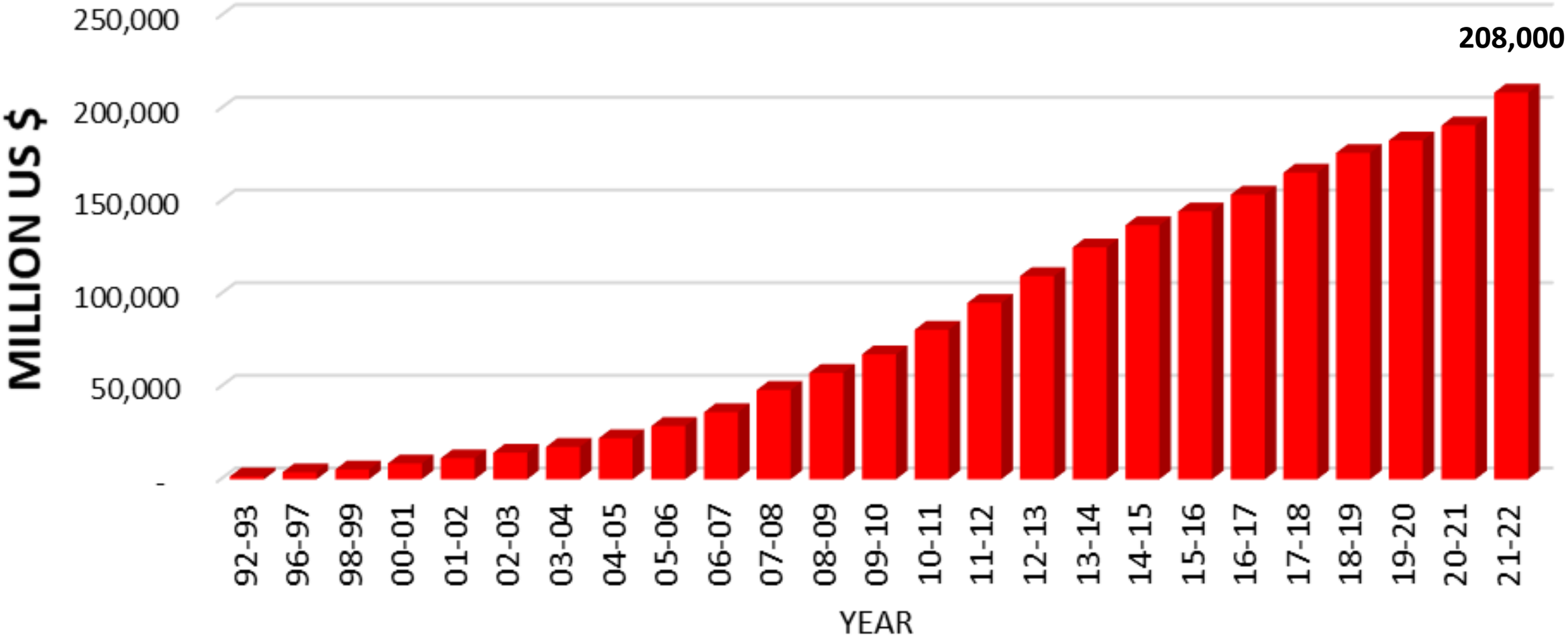



IMPORT OF CRUDE OIL AND PETROLEUM PRODUCTS IN PAKISTAN
Crude Oil, 5,599
Petroleum Products, 12,069
YEAR
21-22
20-21
19-20
18-19
17-18
16-17
15-16
14-15
13-14
12-13
11-12
10-11
09-10
08-09
07-08
06-07
05-06
04-05
03-04
02-03
01-02
00-01
98-99
96-97
92-93
-
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
MILLION DOLLARS

PATTERN OF OIL REFINING: IMPORTED VERSUS LOCAL CRUDE



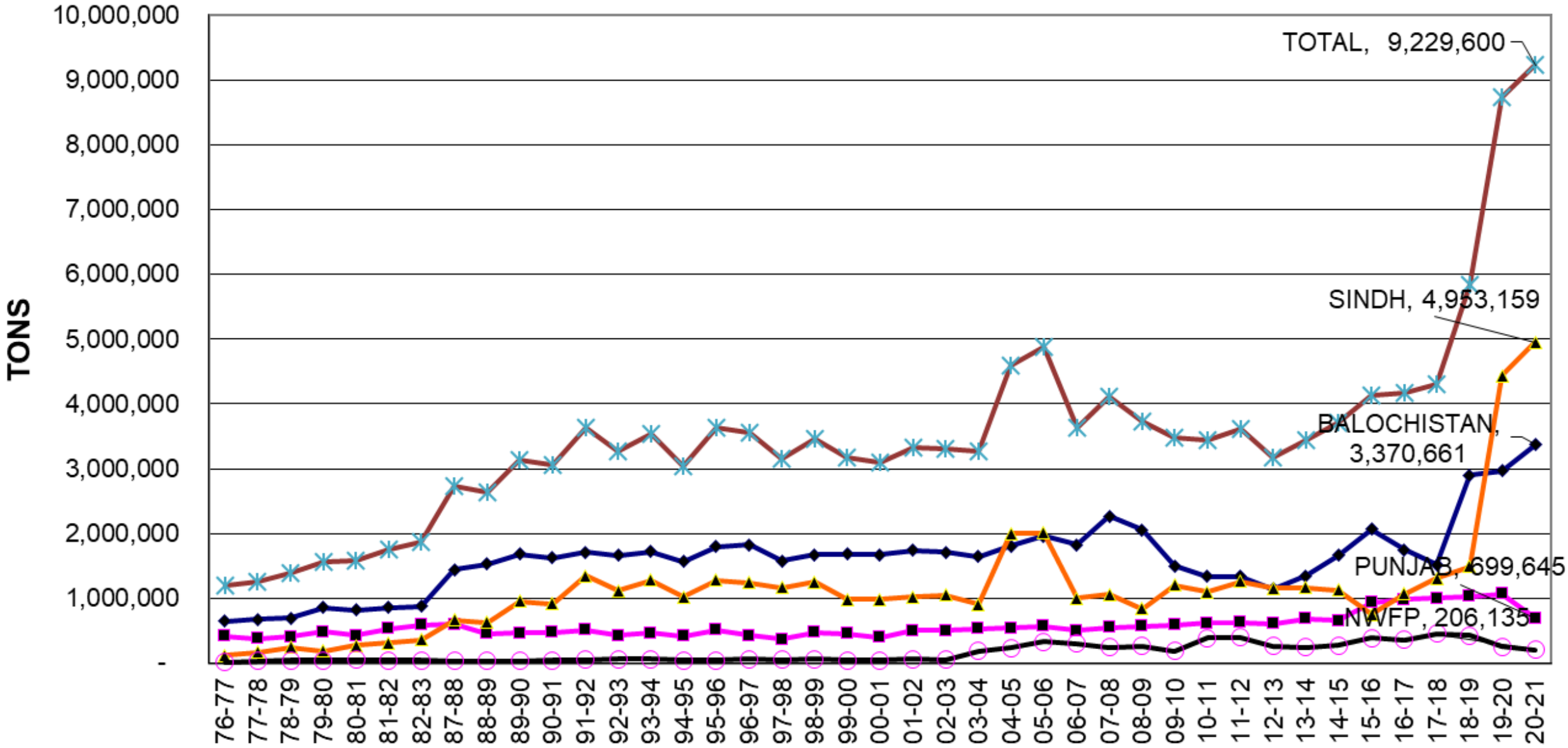
CUMULATIVE FINANCIAL IMPLICATIONS OF PETROLEUM & PETROLEUM PRODUCTS IMPORTS IN PAKISTAN



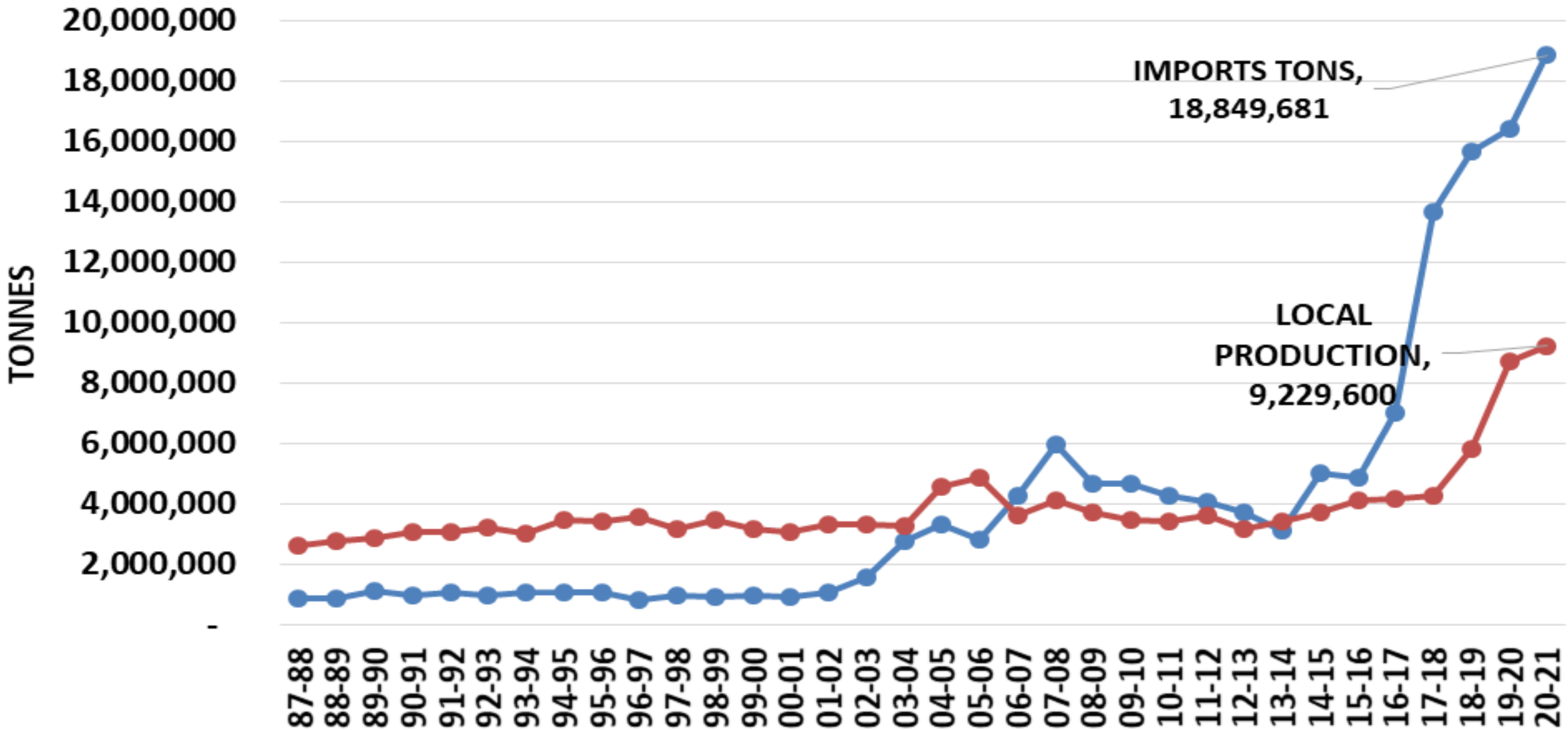
STATE OF TECHNOLOGY IN FOSSIL FUELS

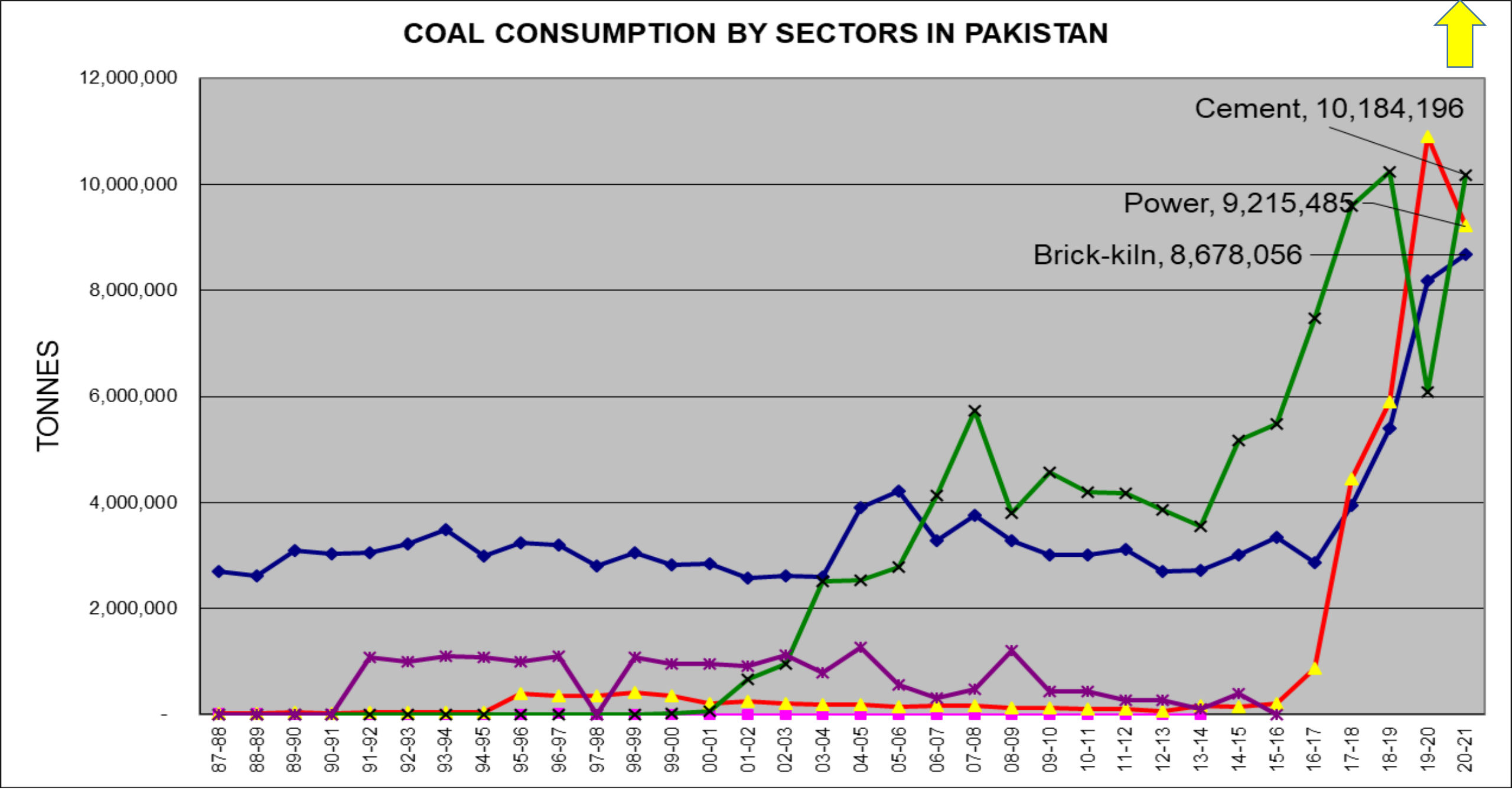
Drilling rigs in Pakistan	OGDCL	MPCL	UEPL	MOL	AL-HAJ	TOTAL
	8	1	4	1	1	15

COAL PRODUCTION IN PROVINCES IN PAKISTAN



LOCAL COAL PRODUCTION VERSUS IMPORTS IN PAKISTAN




COAL CONSUMPTION BY SECTORS IN PAKISTAN
TONNES
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
-
Cement, 10,184,196
Power, 9,215,485
Brick-kiln, 8,678,056
87-88
88-89
89-90
90-91
91-92
92-93
93-94
94-95
95-96
96-97
97-98
98-99
99-00
00-01
01-02
02-03
03-04
04-05
05-06
06-07
07-08
08-09
09-10
10-11
11-12
12-13
13-14
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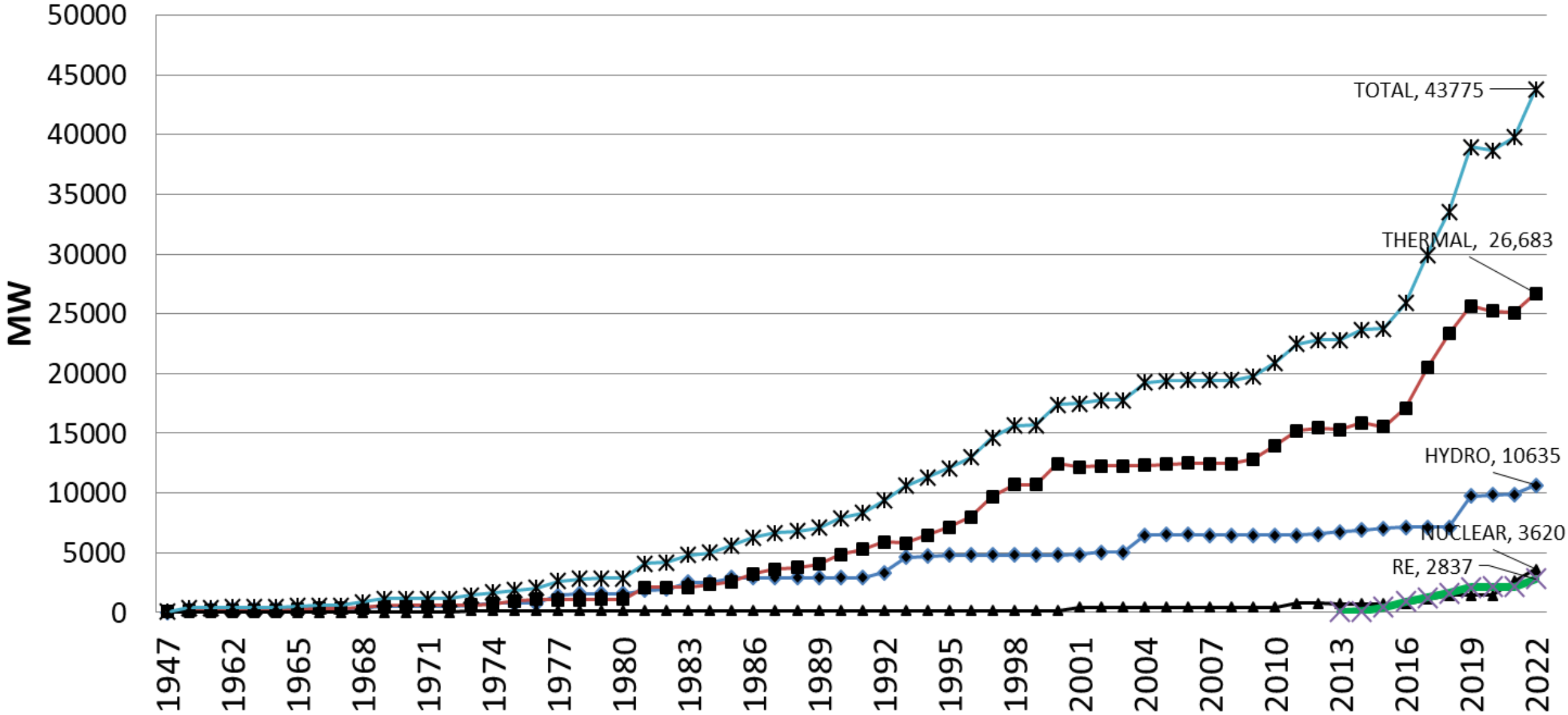
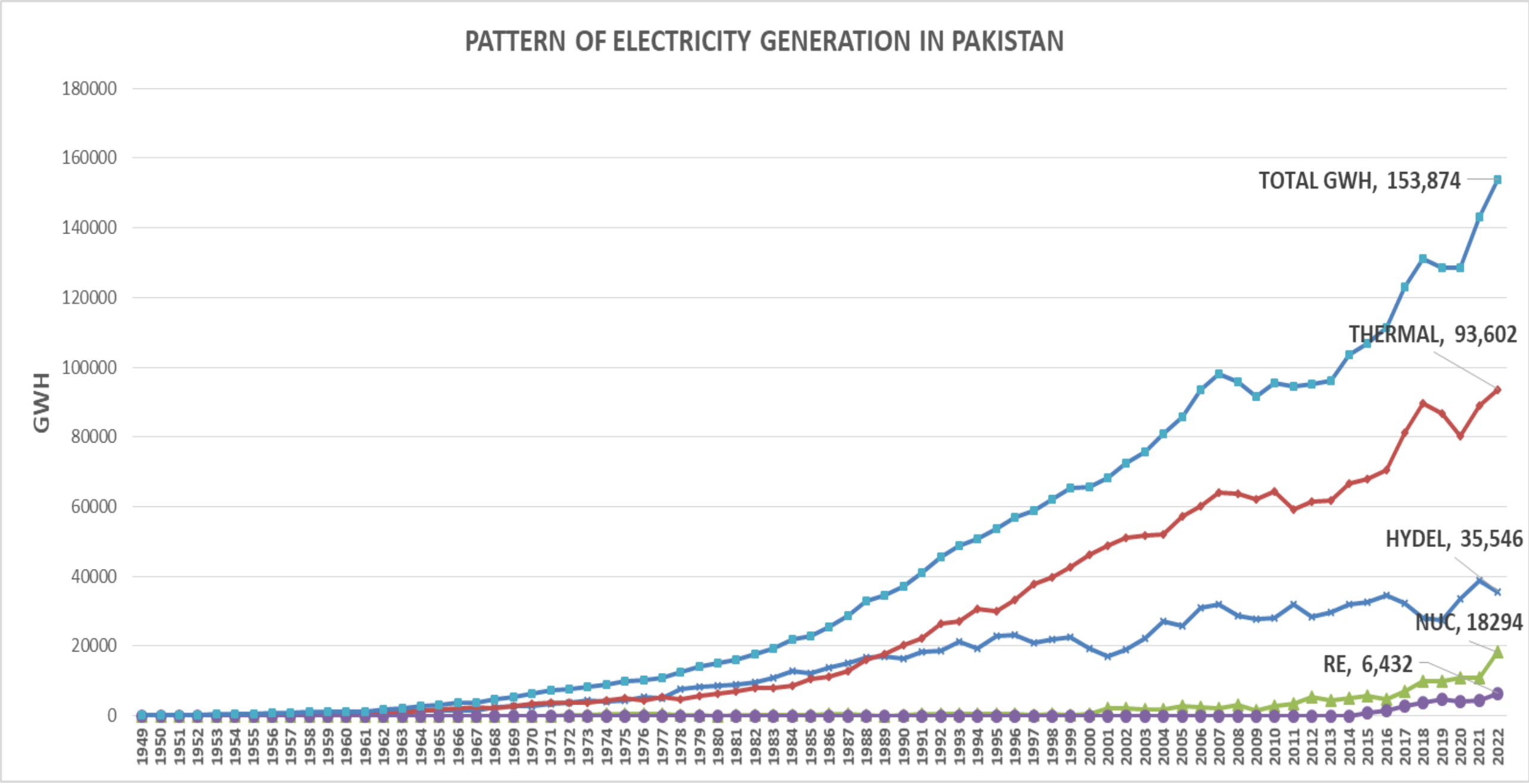
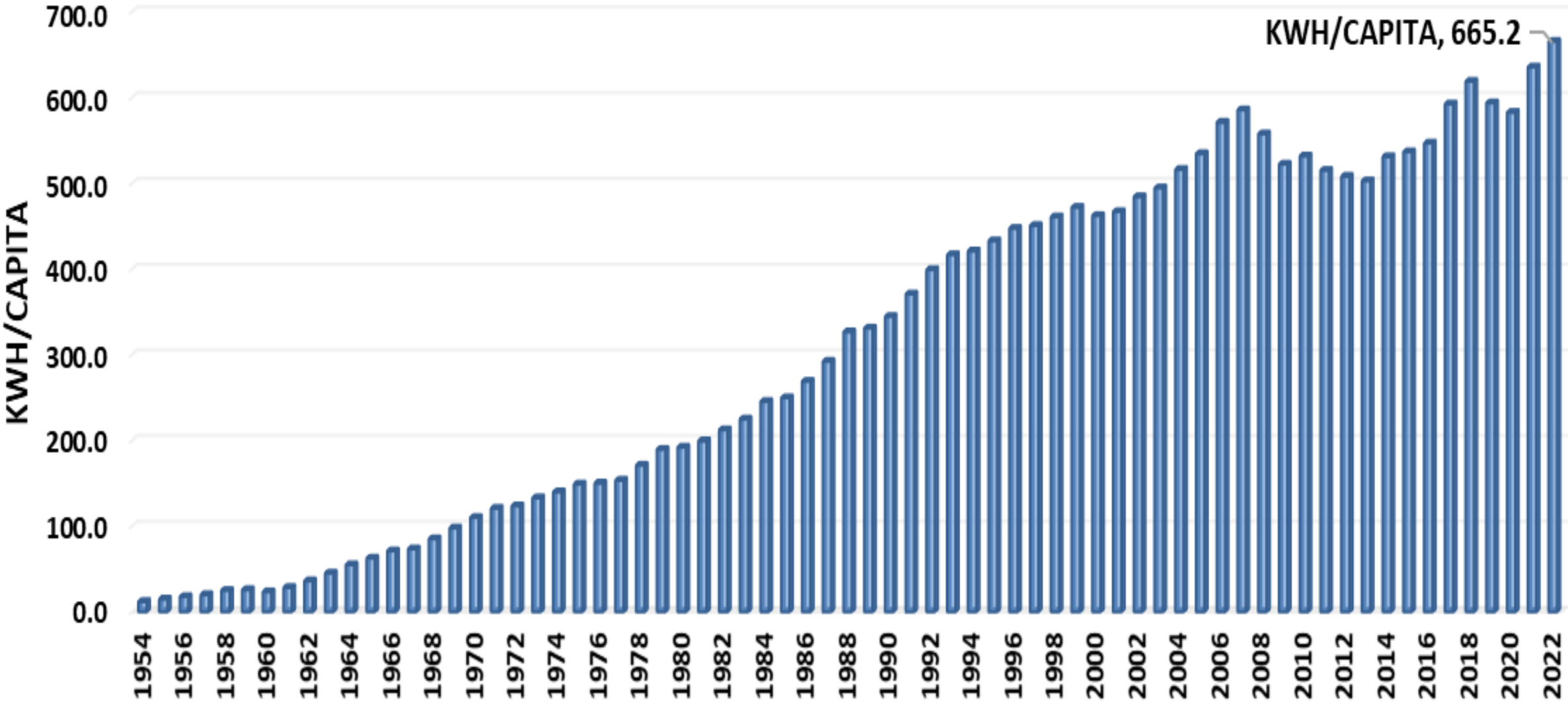
19-20
20-21

GROWTH OF INSTALLED ELECTRICITY GENERATION CAPACITY IN PAKISTAN

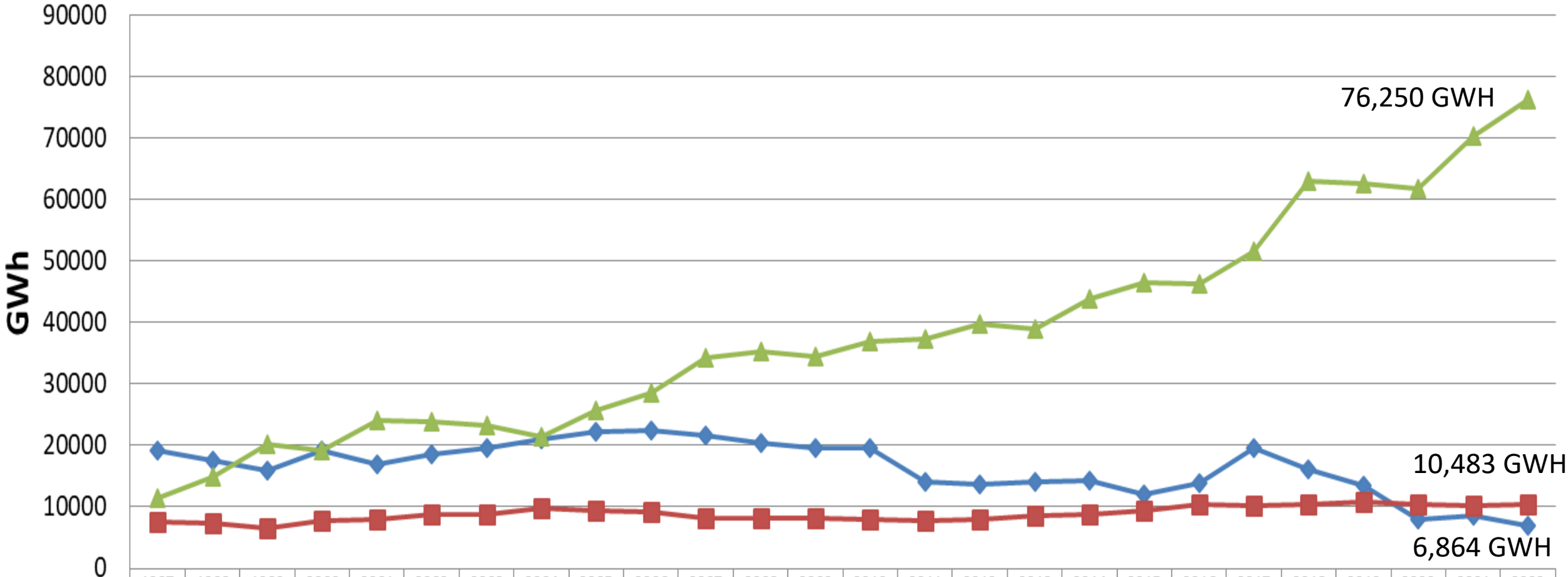



PATTERN OF ELECTRICITY GENERATION IN PAKISTAN
GWH
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
TOTAL GWH, 153,874
THERMAL, 93,602
HYDEL, 35,546
NUC, 18294
RE, 6,432
1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

PER CAPITA ELECTRICITY CONSUMPTION IN PAKISTAN

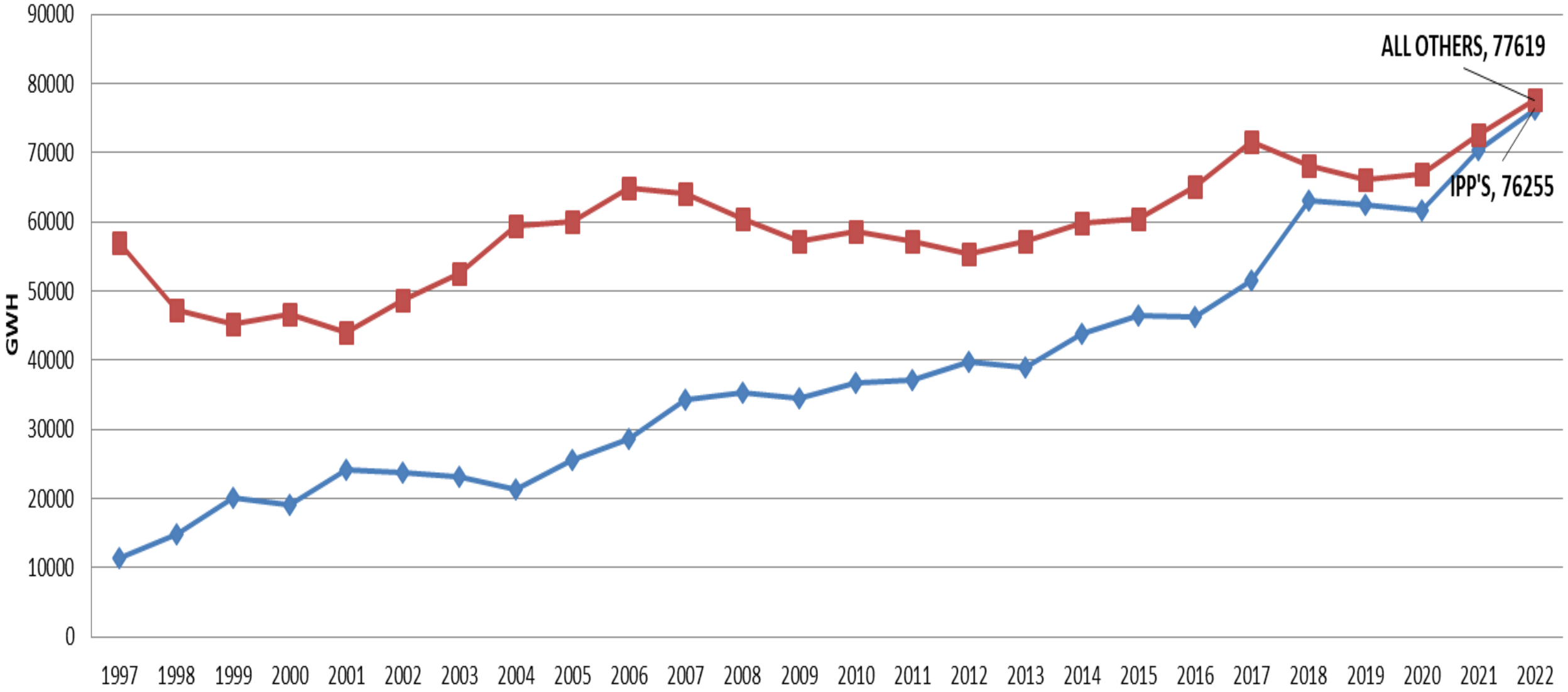


POWER GENERATION IN THERMAL SECTOR (GWH) IN PAKISTAN

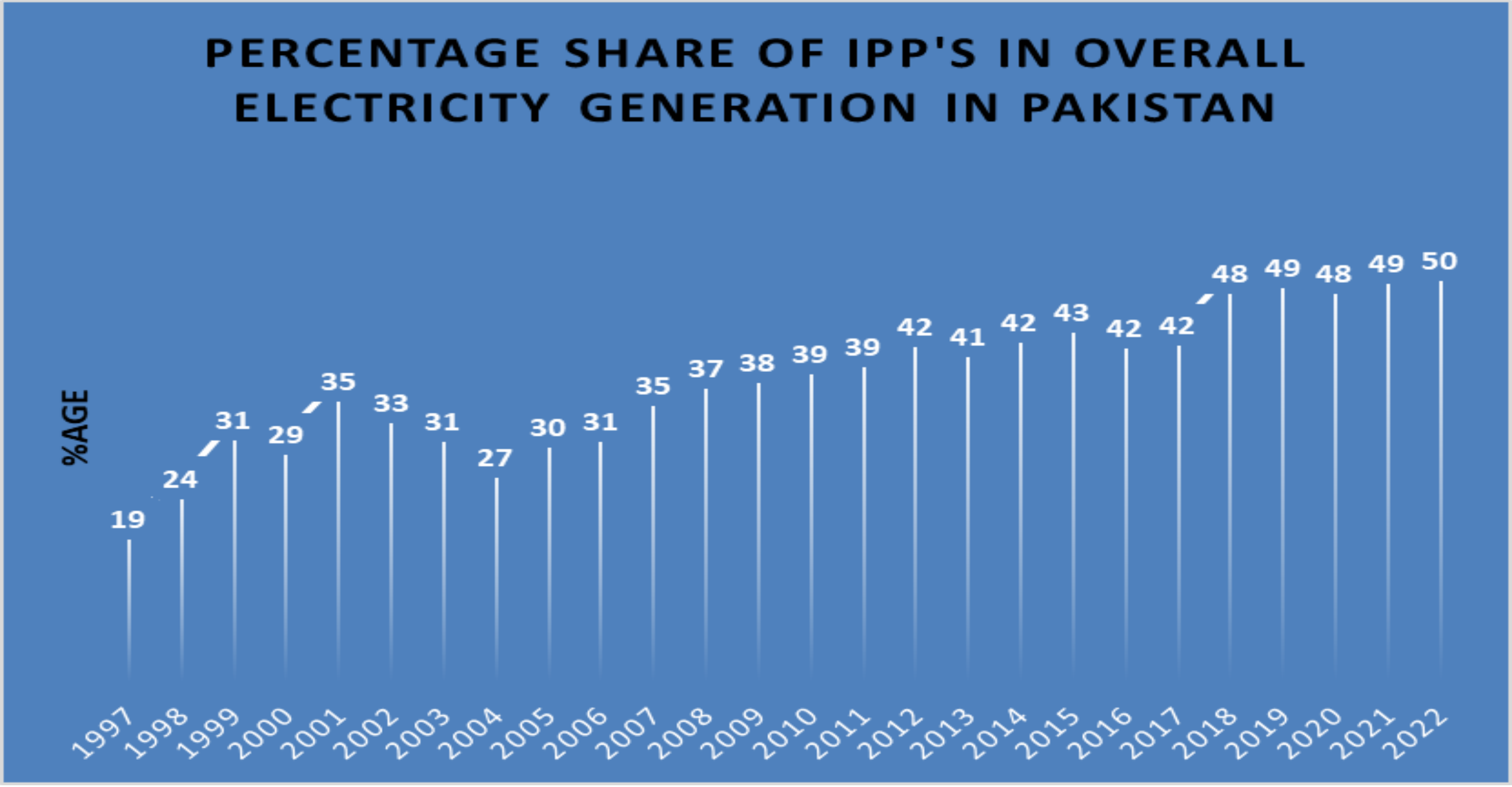


	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
WAPDA	19094	17450	15884	19137	16835	18659	19,574	20,972	22,189	22,508	21,597	20,427	19,521	19,593	14,112	13,605	14,148	14,236	12,133	13,917	19,572	16,193	13,378	8,063	8,513	6864
KESC	7458	7318	6613	7745	7990	8709	8,808	9,724	9,304	9,130	8,169	8,219	8,262	7,964	7,826	8,029	8,567	8,709	9,318	10,323	10,147	10,338	10,727	10,35	10,18	10483
IPP'S	11363	14902	20171	19182	24101	23805	23,209	21,426	25,669	28,645	34,206	35,231	34,431	36,814	37,214	39,674	38,996	43,761	46,435	46,272	51,550	63,082	62,496	61,70	70,39	76255

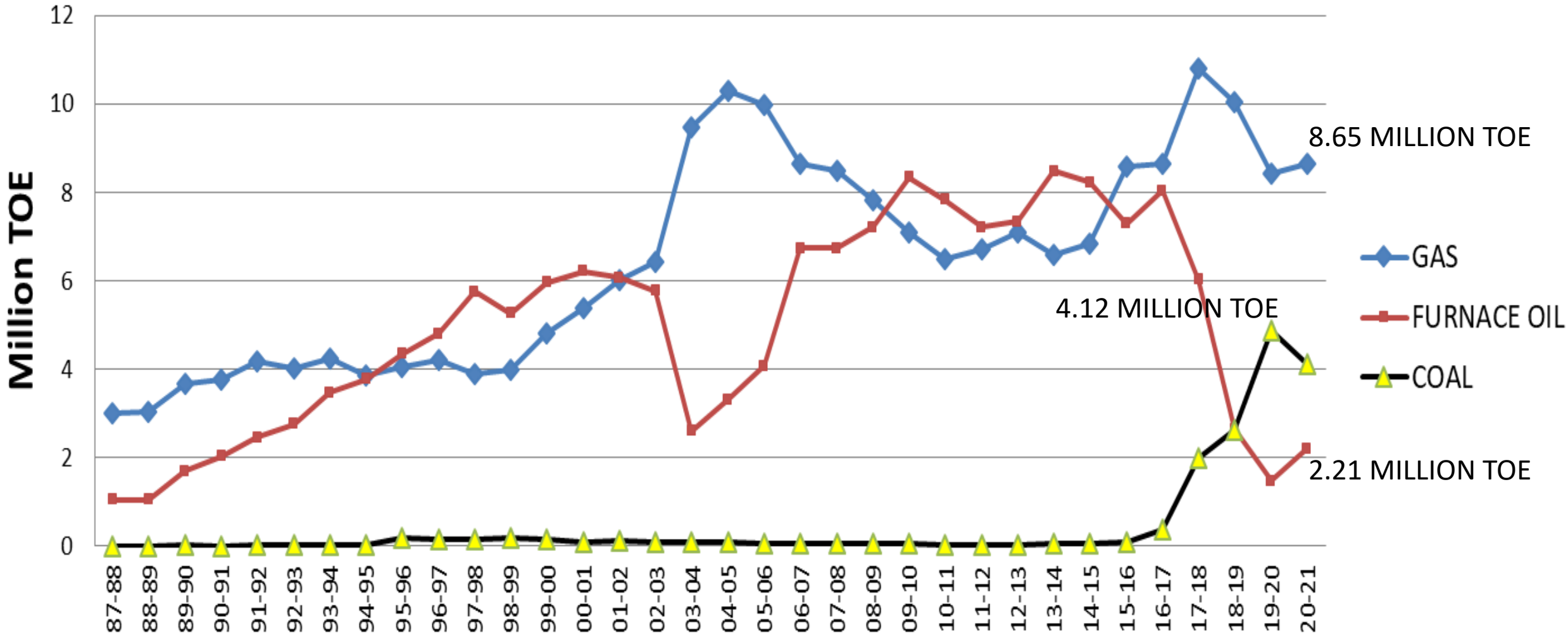
COMPARISON OF ELECTRCITY GENERATION BETWEEN IPP'S VERSUS ALL OTHER SOURCES IN PAKISTAN

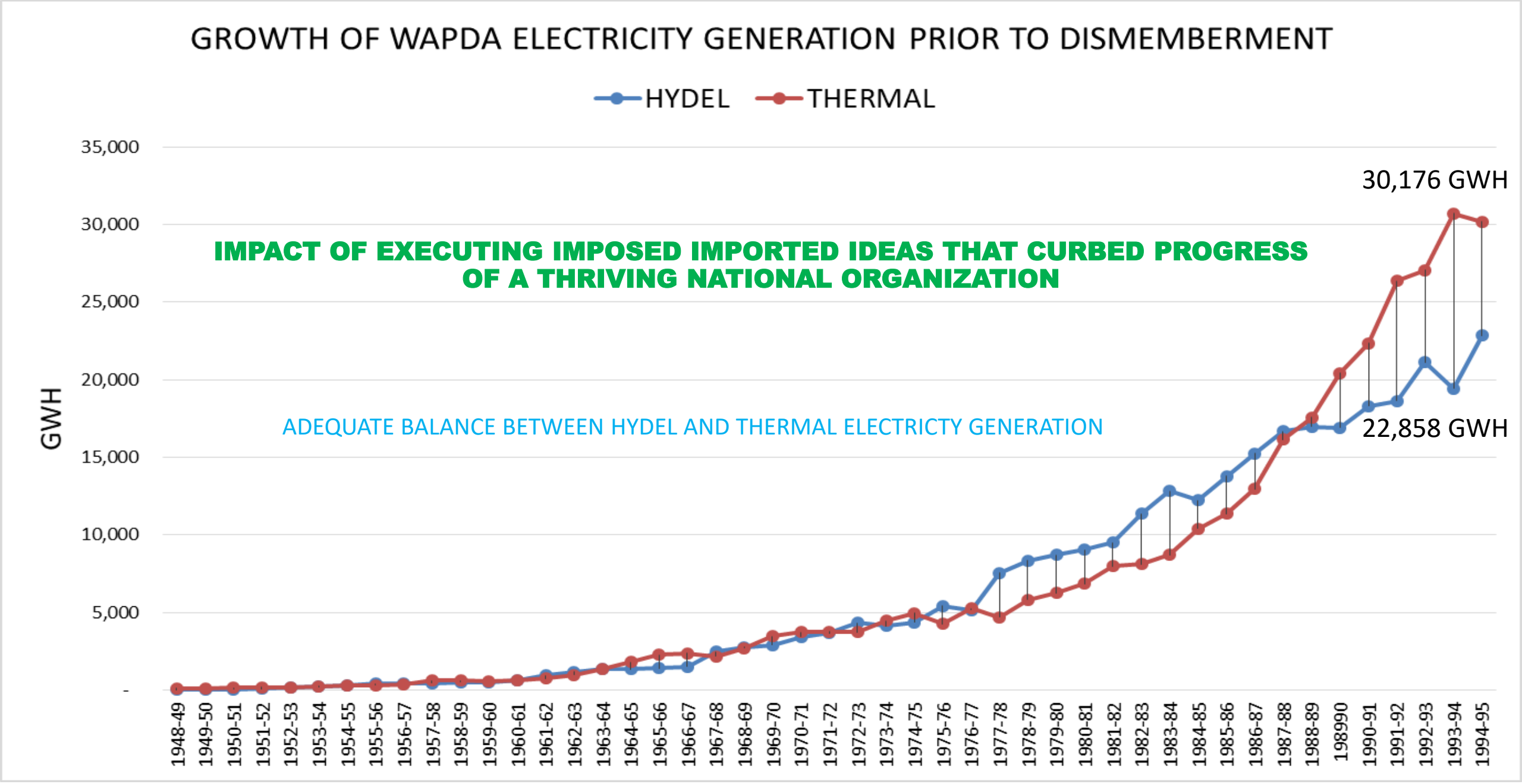


PERCENTAGE SHARE OF IPP'S IN OVERALL ELECTRICITY GENERATION IN PAKISTAN

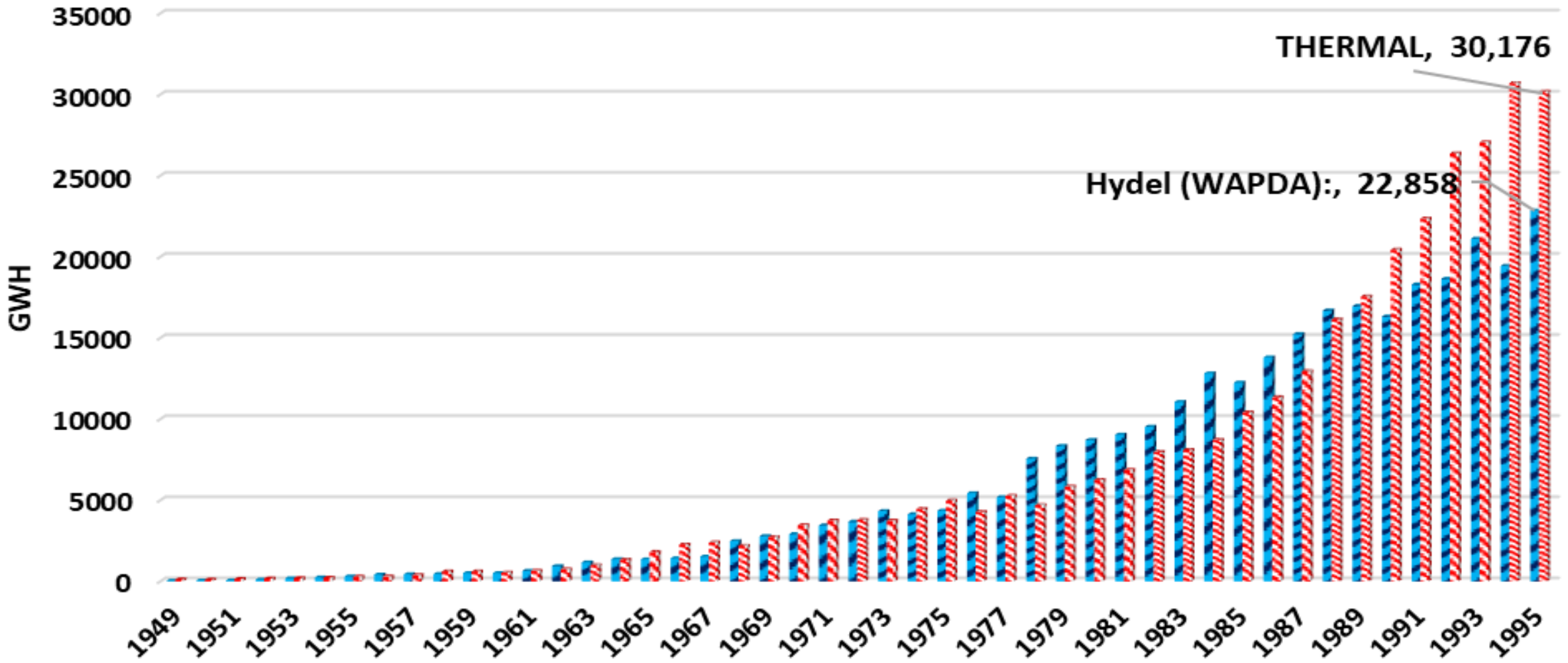


PATTERN OF FUEL CONSUMPTION IN THERMAL POWER SECTOR IN PAKISTAN

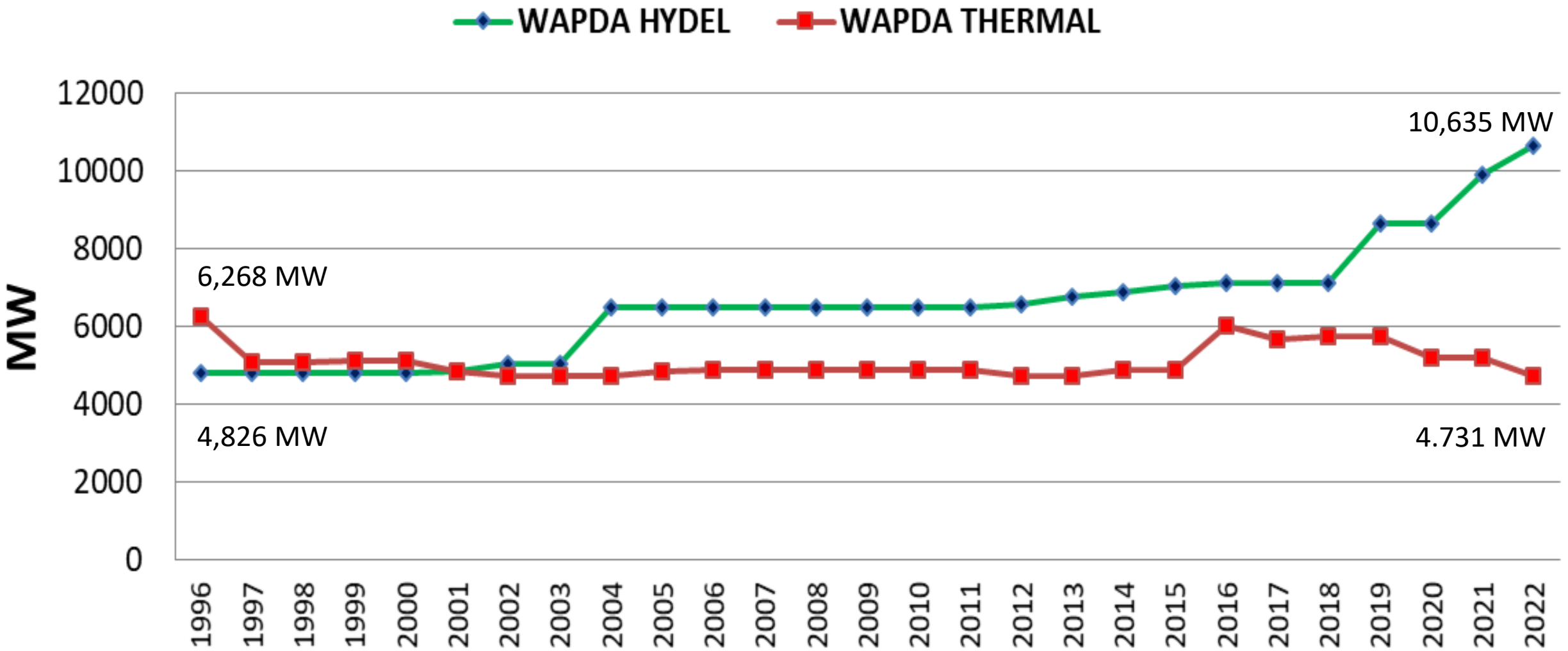



GROWTH OF WAPDA ELECTRICITY GENERATION PRIOR TO DISMEMBERMENT
HYDEL
THERMAL
GWH
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
30,176 GWH
22,858 GWH
IMPACT OF EXECUTING IMPOSED IMPORTED IDEAS THAT CURBED PROGRESS OF A THRIVING NATIONAL ORGANIZATION
ADEQUATE BALANCE BETWEEN HYDEL AND THERMAL ELECTRICTY GENERATION
1948-49
1949-50
1950-51
1951-52
1952-53
1953-54
1954-55
1955-56
1956-57
1957-58
1958-59
1959-60
1960-61
1961-62
1962-63
1963-64
1964-65
1965-66
1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77
1977-78
1978-79
1979-80
1980-81
1981-82
1982-83
1983-84
1984-85
1985-86
1986-87
1987-88
1988-89
198990
1990-91
1991-92
1992-93
1993-94
1994-95

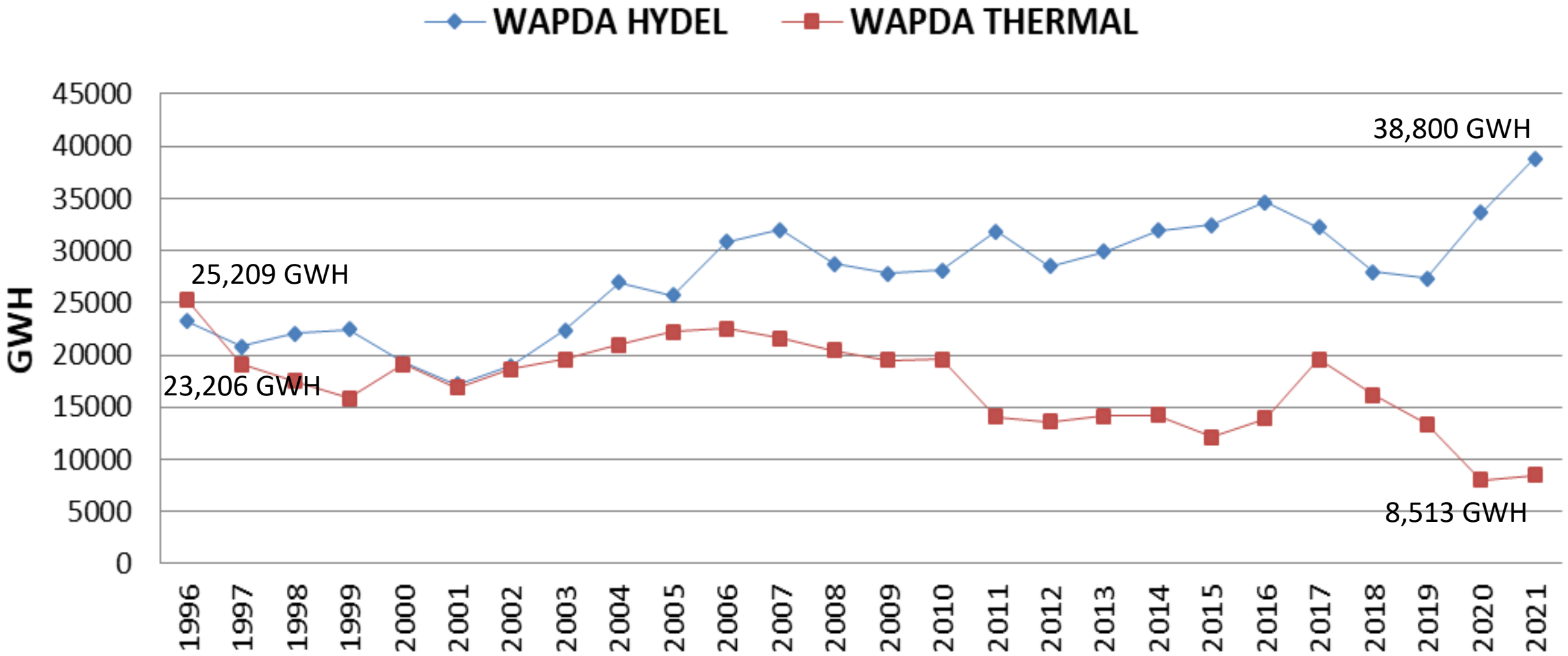
GROWTH OF ELECTRICITY GENERATION PRIOR TO WAPDA DISINTEGRATION



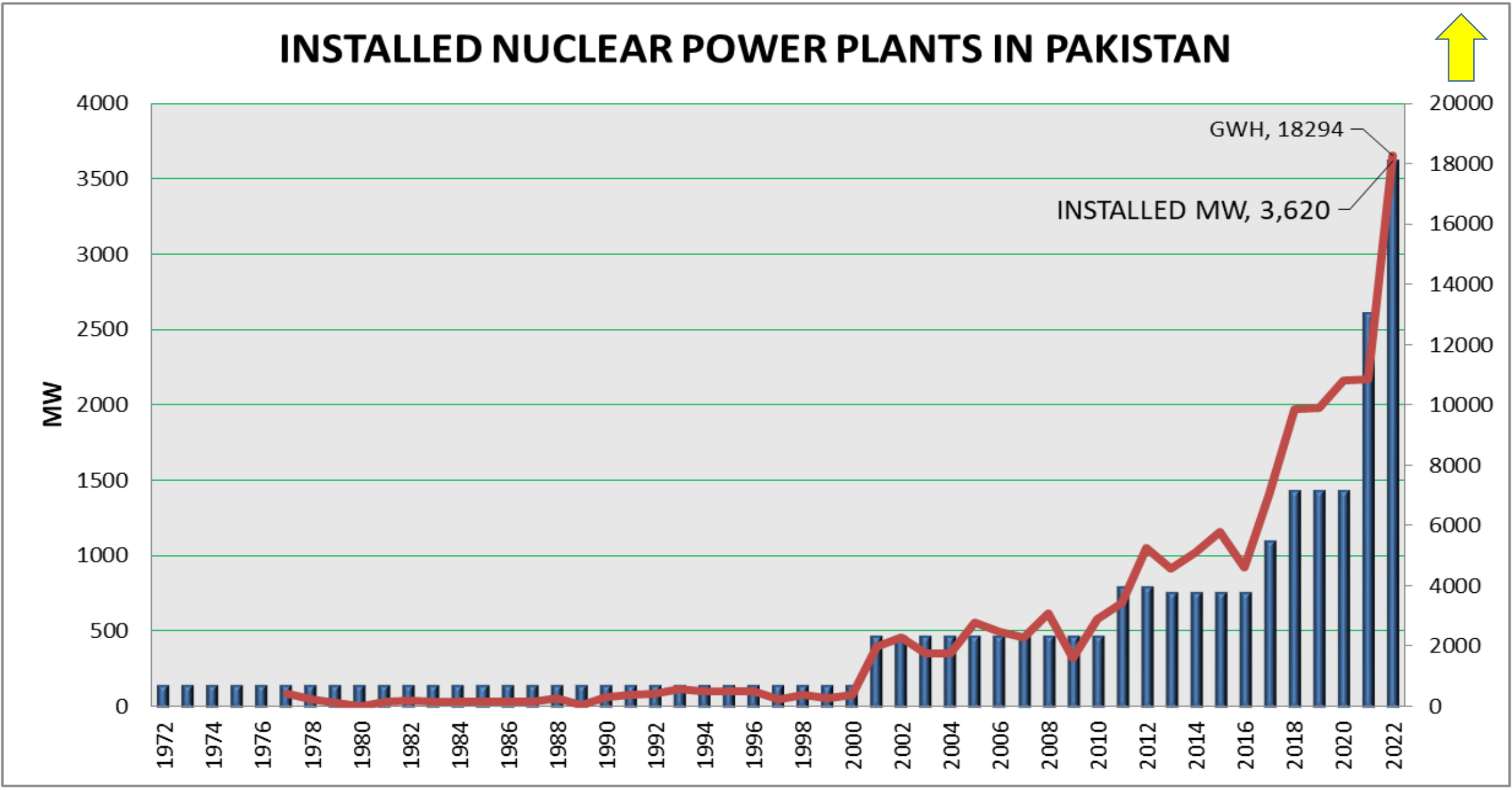
ENHANCEMENT IN INSTALLED POWER BY WAPDA AFTER DISMEMBERMENT IN THE YEAR 1995



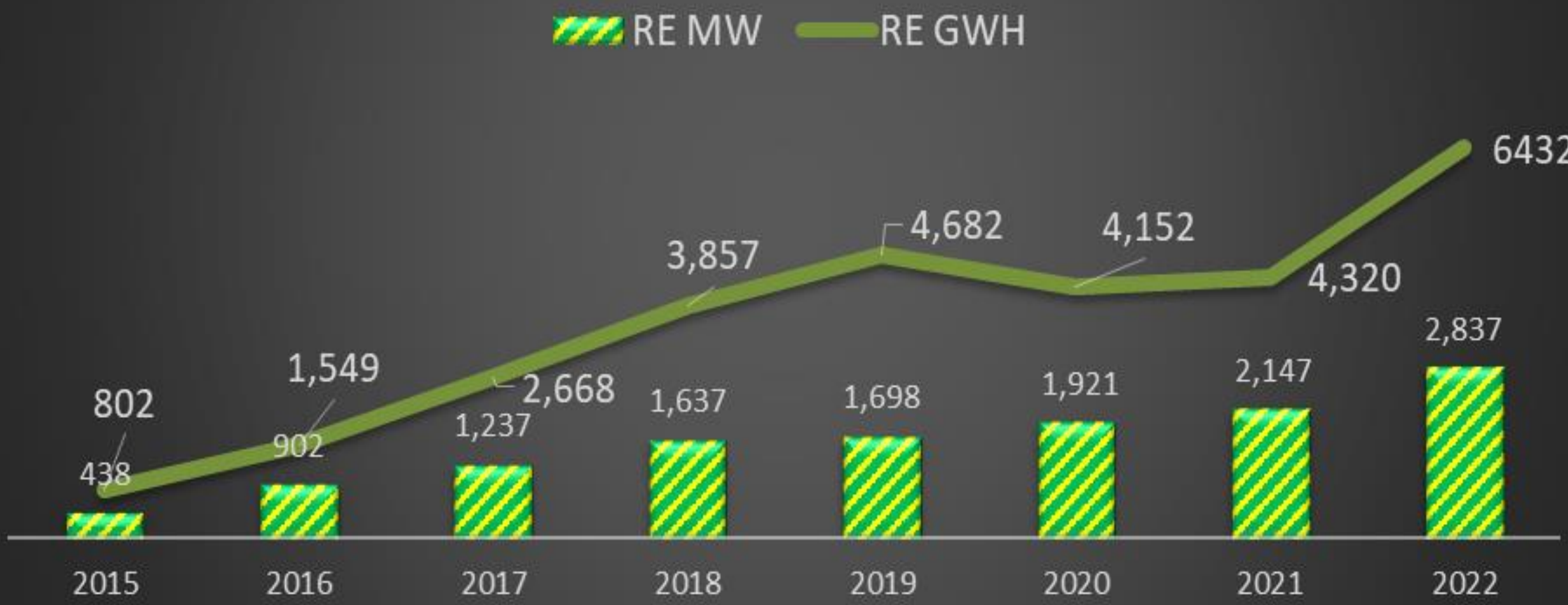
ELECTRICITY GENERATION BY WAPDA ENTITIES AFTER DISMEMBERMENT IN THE YEAR 1995



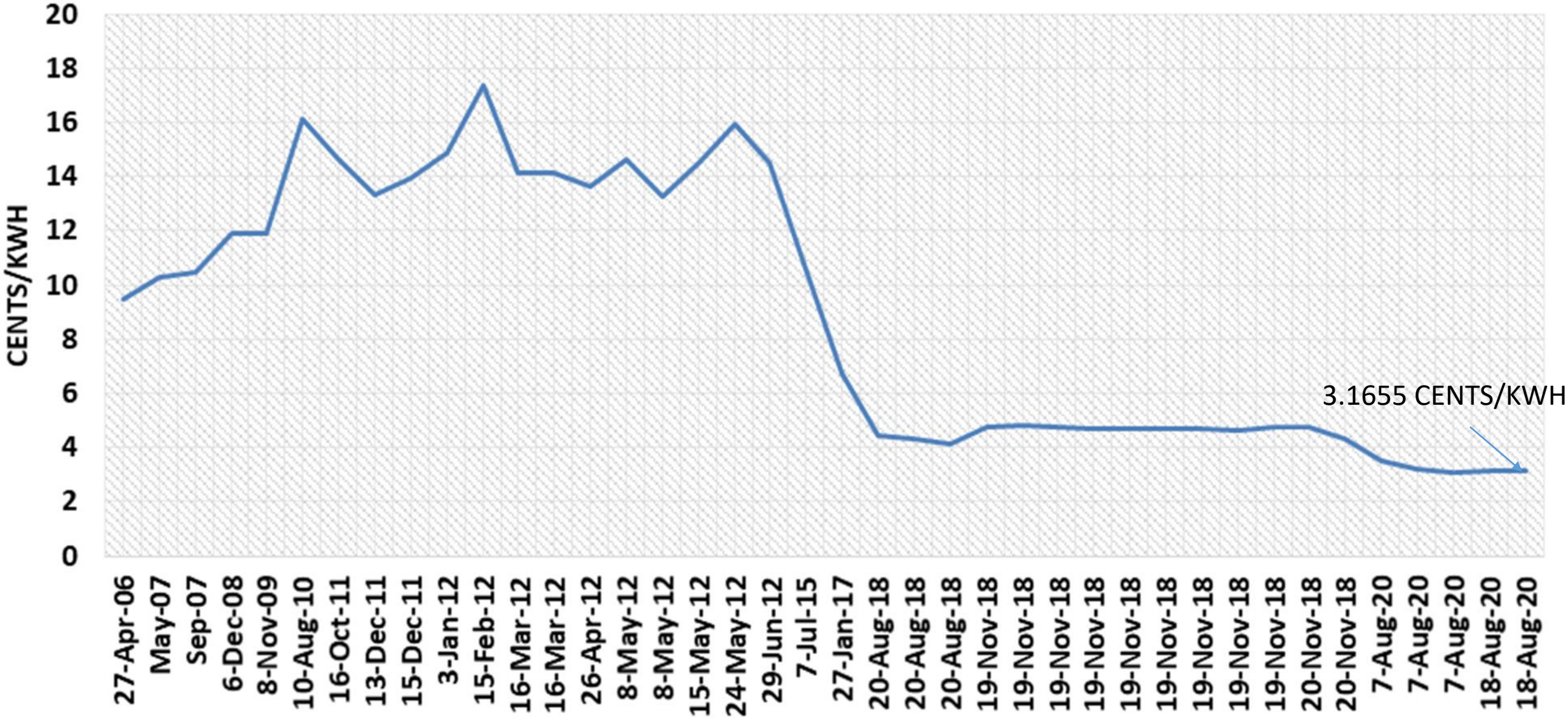
INSTALLED NUCLEAR POWER PLANTS IN PAKISTAN

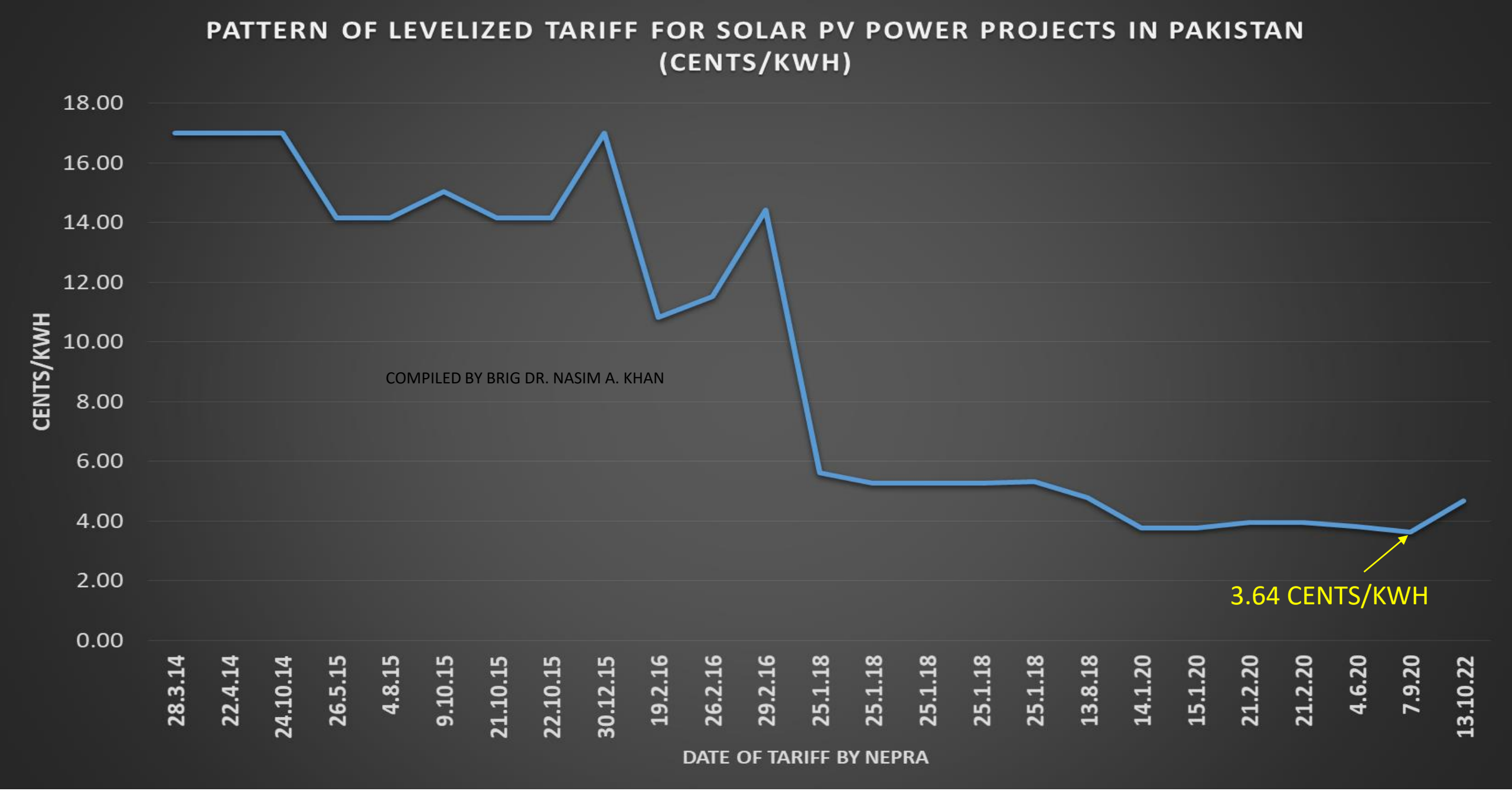


INSTALLED POWER AND ENERGY GENERATED FROM RENEWABLE ENERGY IN PAKISTAN

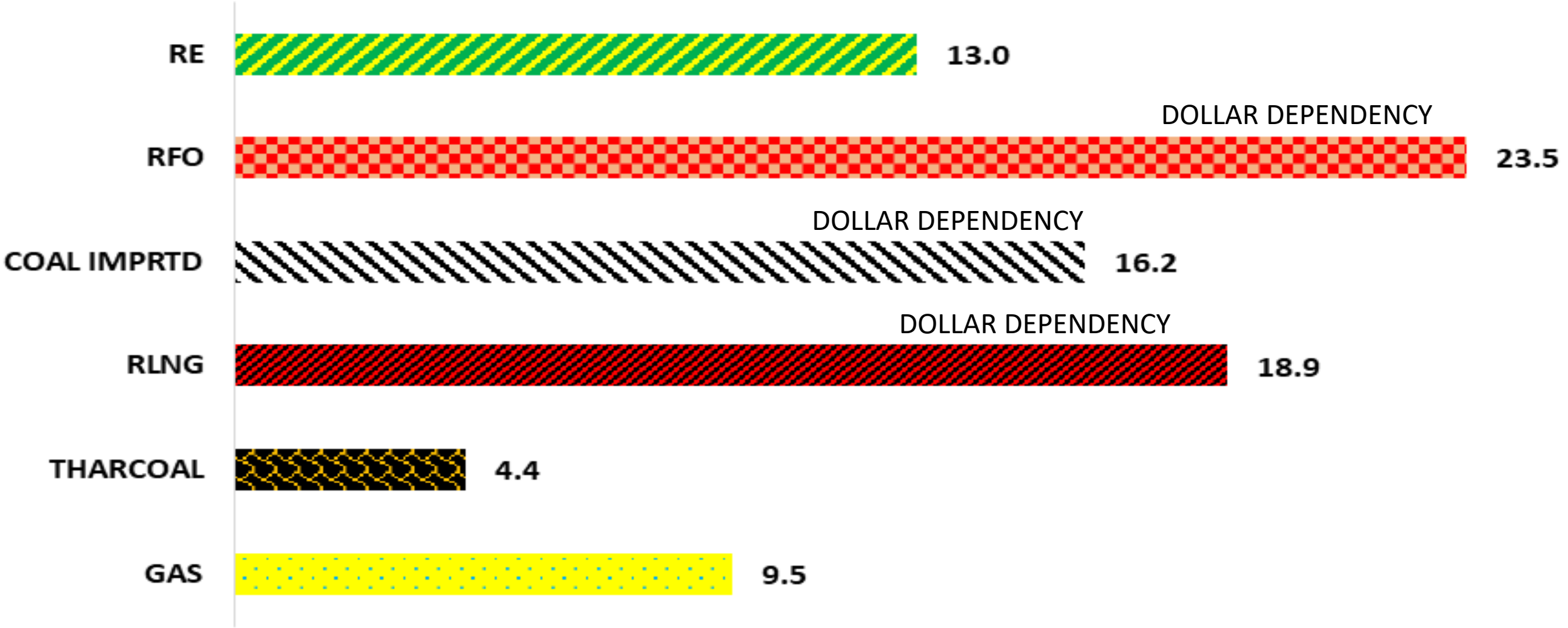


PATTERN OF WIND POWER TARIFF IN PAKISTAN

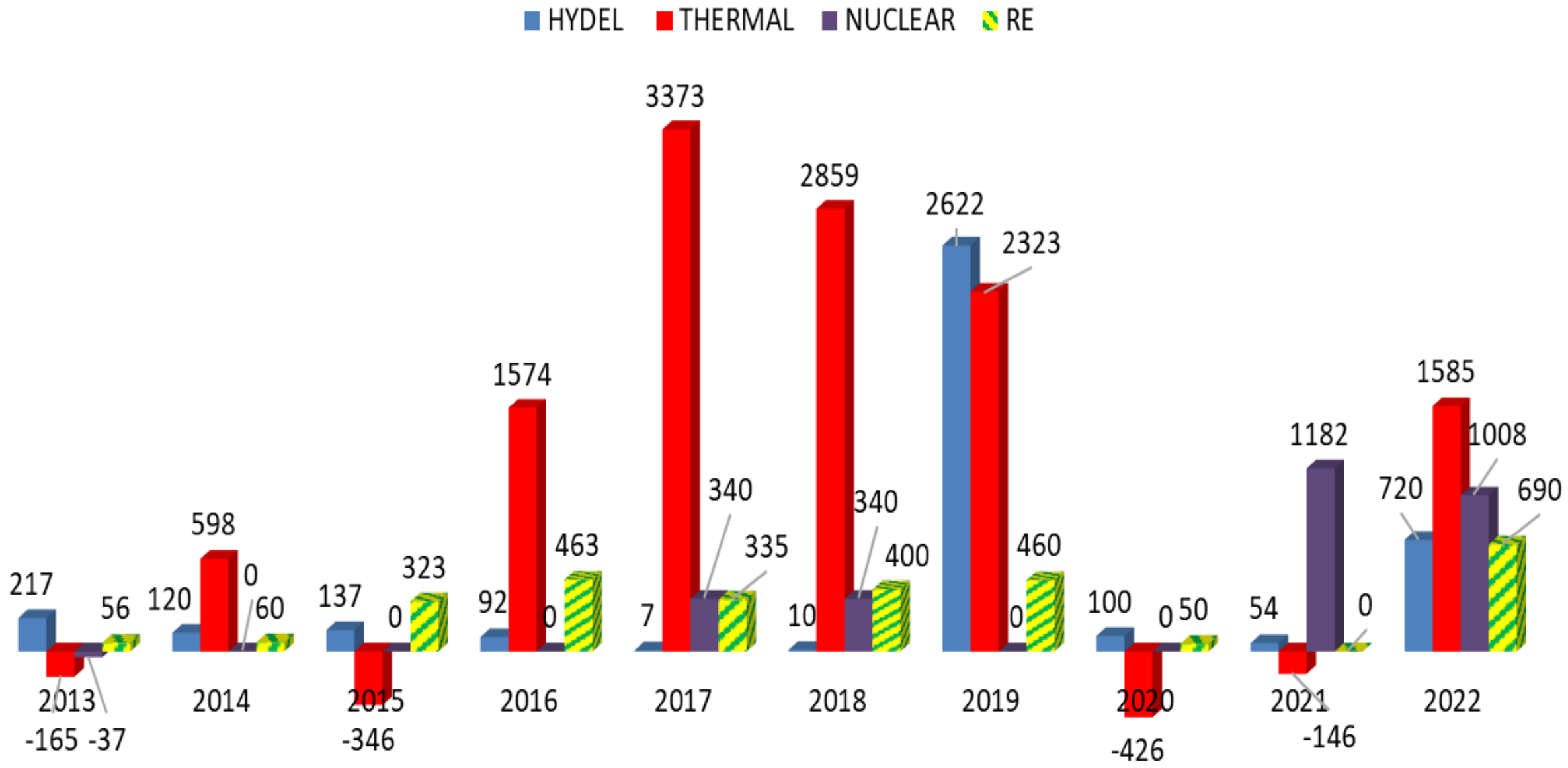



PATTERN OF LEVELIZED TARIFF FOR SOLAR PV POWER PROJECTS IN PAKISTAN
(CENTS/KWH)
CENTS/KWH
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
COMPILED BY BRIG DR. NASIM A. KHAN
3.64 CENTS/KWH
28.3.14
22.4.14
24.10.14
26.5.15
4.8.15
9.10.15
21.10.15
22.10.15
30.12.15
19.2.16
26.2.16
29.2.16
25.1.18
25.1.18
25.1.18
25.1.18
25.1.18
13.8.18
14.1.20
15.1.20
21.2.20
21.2.20
4.6.20
7.9.20
13.10.22
DATE OF TARIFF BY NEPRA

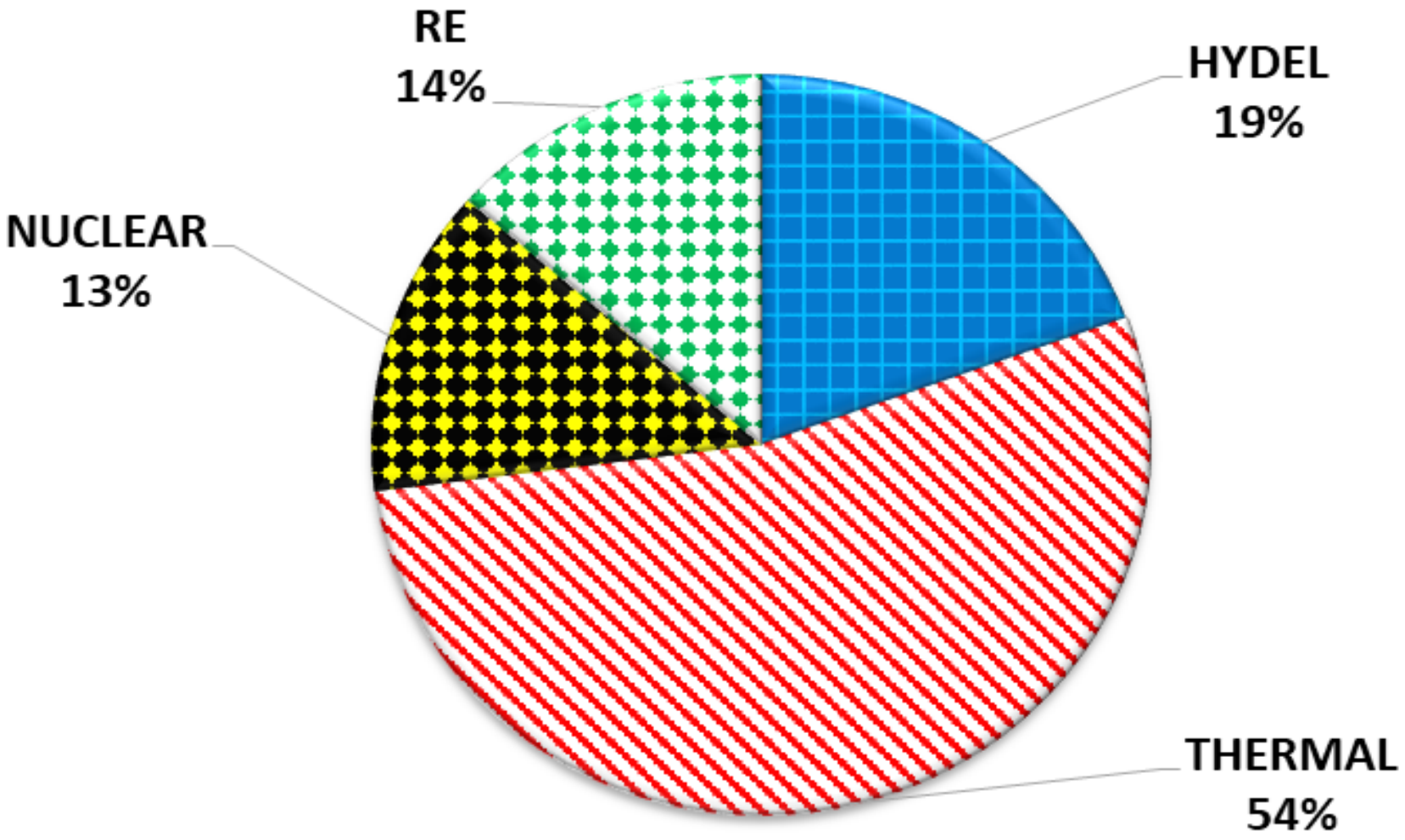
COST OF ELECTRICITY GENERATION BASED ON NTDC MERIT ORDER DEC 2022

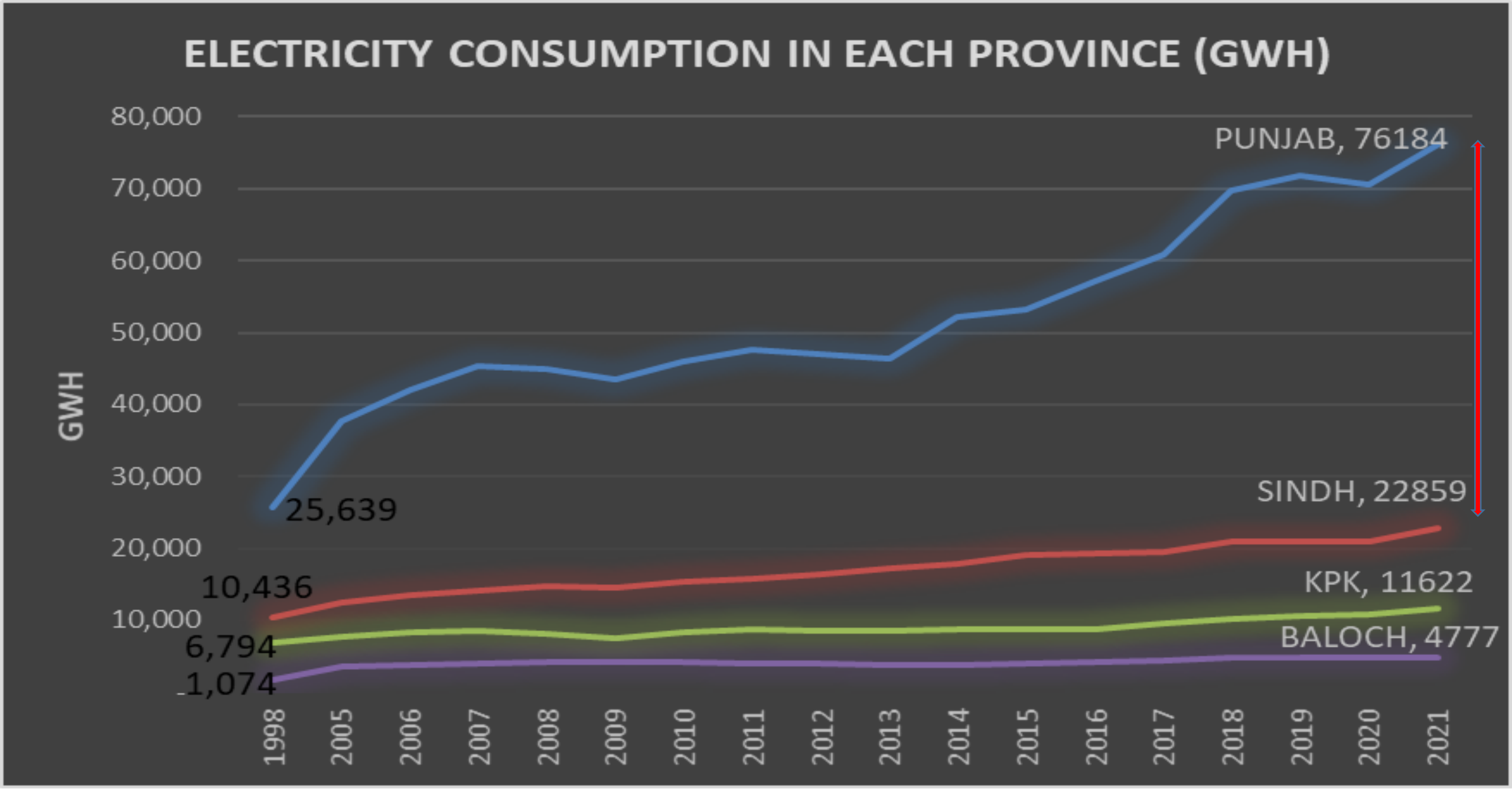


NEW POWER GENERATION CAPACITY ADDED AFTER BEGINNING OF RE POWER INDUCTION

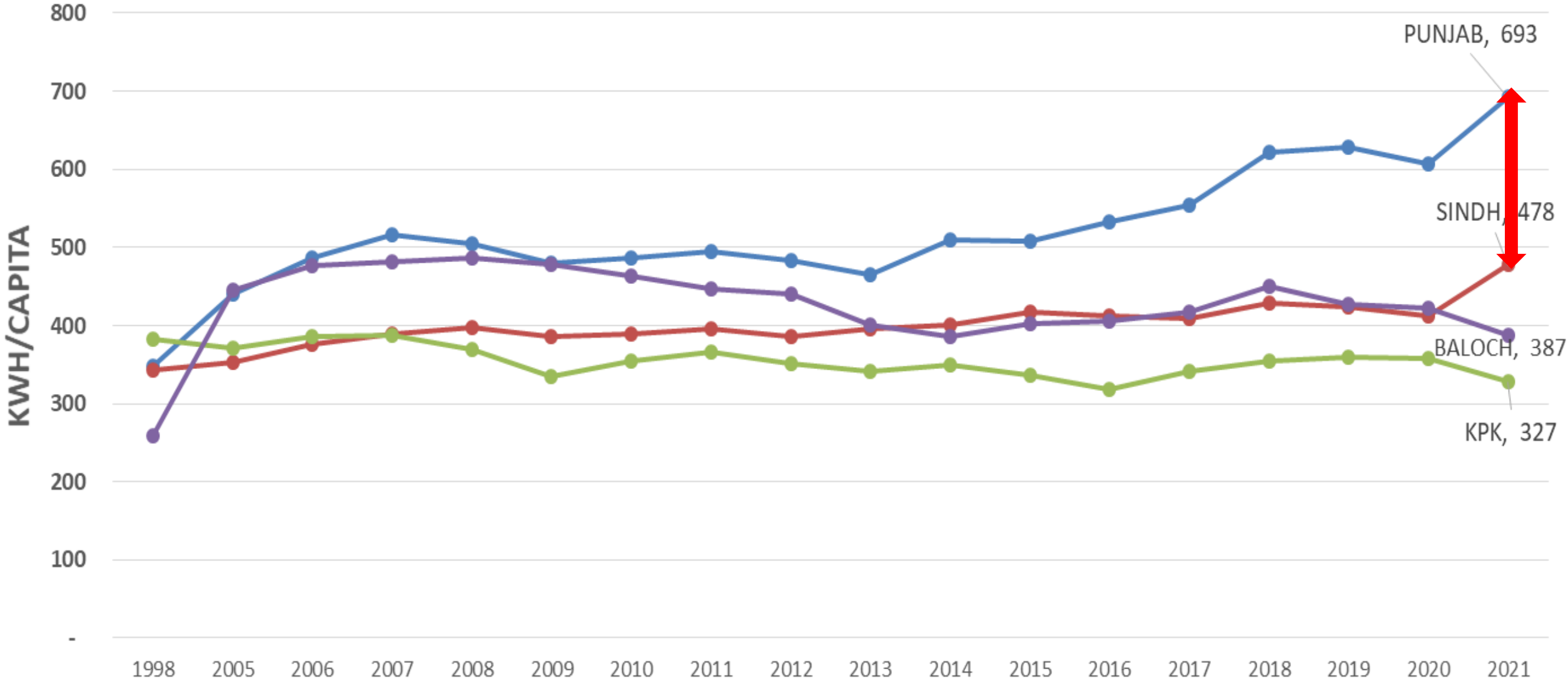


CUMULATIVE SHARE OF INSTALLED ELECTRIC GENERATION CAPACITY SINCE INDUCTION OF RE

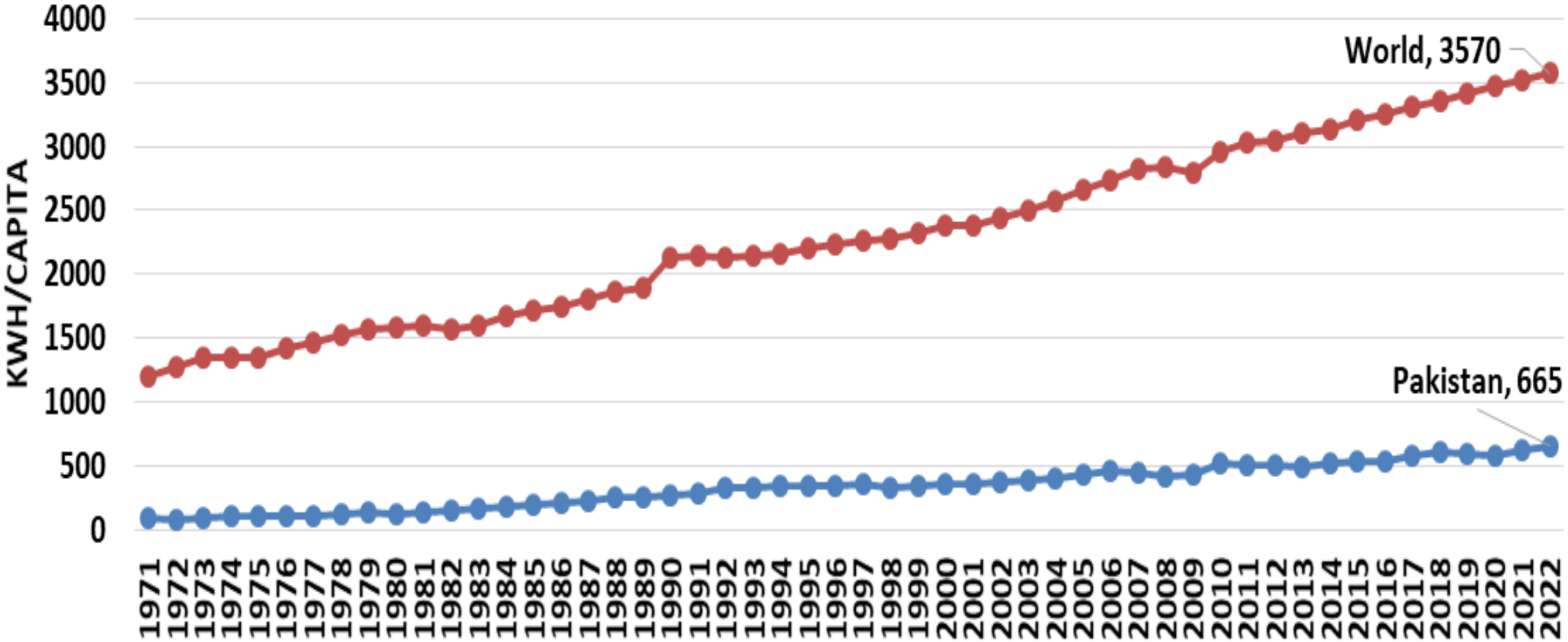



ELECTRICITY CONSUMPTION IN EACH PROVINCE (GWH)
GWH
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
PUNJAB, 76184
SINDH, 22859
KPK, 11622
BALOCH, 4777
25,639
10,436
6,794
1,074
1998
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

PER CAPITA ELECTRICITY CONSUMPTION (KWH) IN DIFFERENT PROVINCES OF PAKISTAN



DEFICIT OF ELECTRICITY CONSUMPTION PER CAPITA BETWEEN WORLD AVERAGE AND PAKISTAN

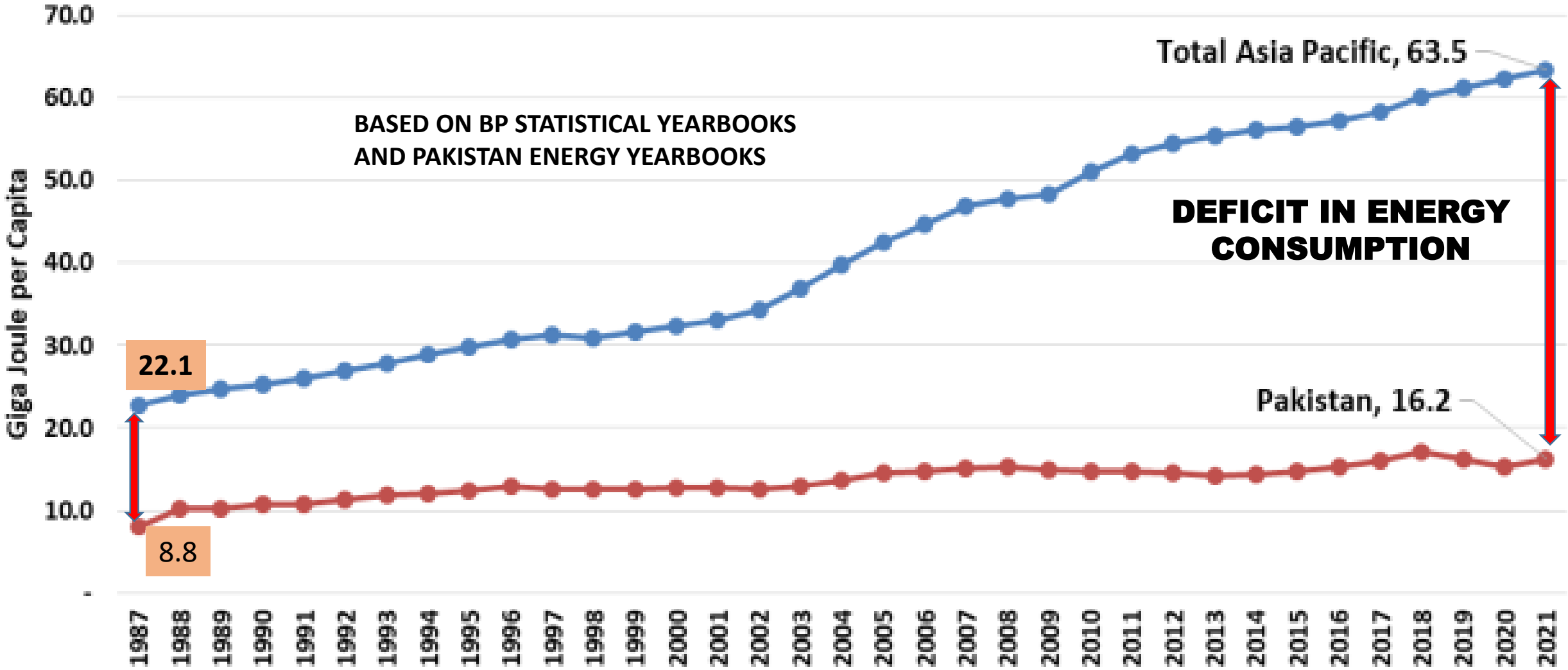


CONCLUSIONS

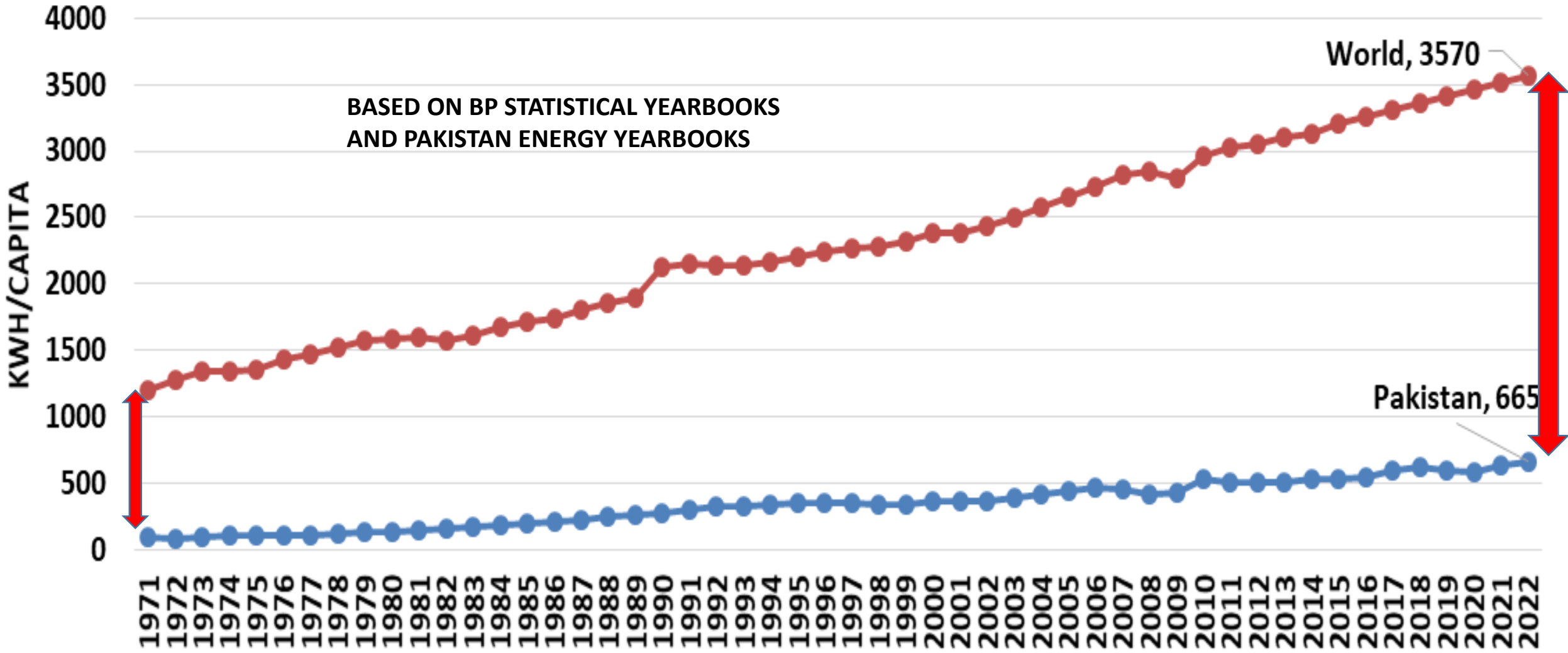
ENERGY IMBROGLIO IN PAKISTAN that is responsible for current Energy Crisis

Organizations involved in Decision Making in Energy Sector									
Federal Ministries	Energy	Energy (Petroleum Division)	Climate Change	Planning, Dev& Reforms	Finance	Water Resources	State Bank of Pakistan	Provincial Energy Ministries	
Regulatory/ Administrative Authorities	National Transmission and Dispatch Company	Pakistan Mineral Development Corporation	Oil and Gas Regulatory Authority	National Energy Efficiency& Conservation Authority	National Electric Power Regulatory Authority	Alternative Energy Development Board	Private Power and Infrastructure Board	Power Holding Ltd	PEDO. DAE, PPB
Executing Agencies	Oil and Gas Development Company Limited	Distribution Companies DISCO's	Central Power Purchase Authority	Indepedant Power Producers IPP'S	Pakistan Atomic Energy Company	Pakistan State Oil	Water and Power Development Authority	Pakistan Electric Power Company	STDC
	Oil Refining Companies	Pakistan Petroleum Limited	Sui Northern Gas Company	Oil Exploration and Production Companies	Sui Southern Gas Company	Geological Survey of Pakistan	National Engineering Services Pakistan	KE GENCOS I TO IV	Sindh/ Thar Coal Board

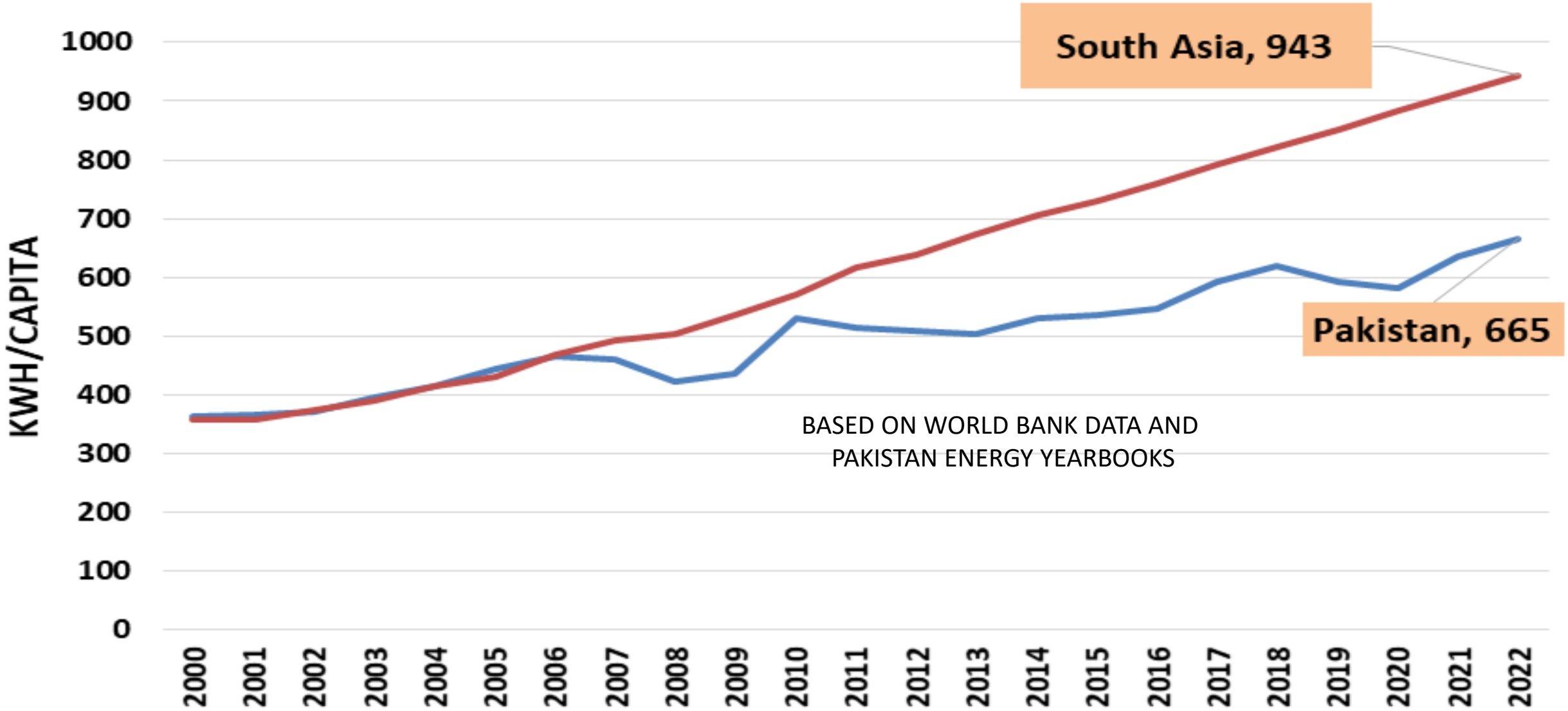
PRIMARY ENERGY PER CAPITA UTILIZATION GAP BETWEEN PAKISTAN AND ASIA PACIFIC NATIONS



DEFICIT OF ELECTRICITY CONSUMPTION PER CAPITA BETWEEN WORLD AVERAGE AND PAKISTAN



PER CAPITA ELECTRICITY CONSUMPTION OF PAKISTAN COMPARED WITH SOUTH ASIA



BASED ON WORLD BANK DATA AND
PAKISTAN ENERGY YEARBOOKS

Recommendations

- **There are more then Thirty ministries, regulatory authorities, and execution agencies. This creates Group Pressure politics and can be avoided by reducing decision making groups. As such it is recommended that number of ministries/ authorities/ Regulatory bodies must be reduced to bare minimum preferably ONE.**

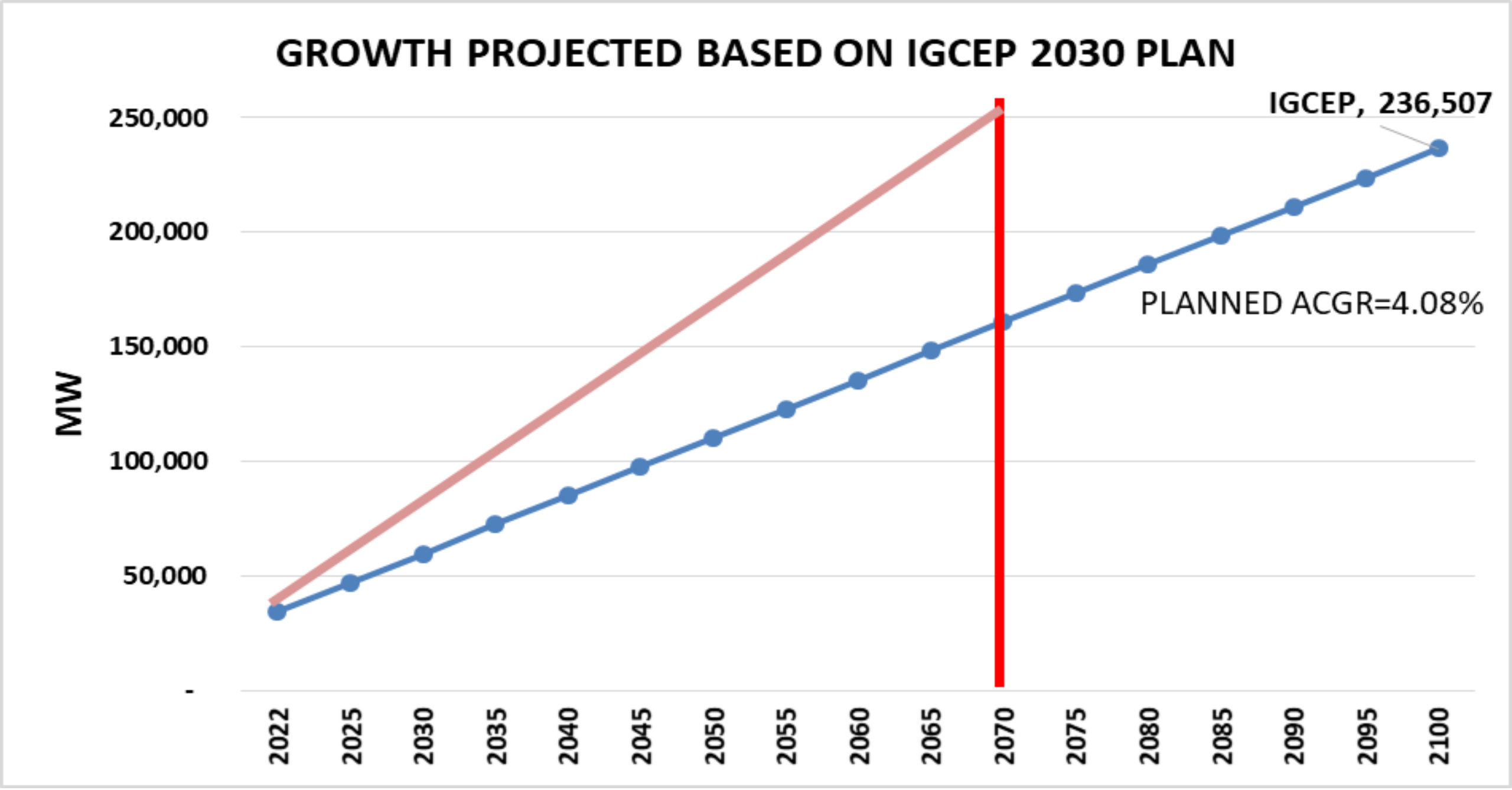
- **The fossil fuel imports consumed 227 Billion dollars in past thirty years yet no technology has been developed indigenously. In next five years time equipment for exploration, drilling, refining AND ATLEAST FUELING STATIONS must be developed indigenously as a National Priority.**

Recommendations

- **Support for RE deployment should be given PRIORITY and RE Power Projects should be given an attractive Tariff compared to Thermal power. This will reduce Dollar Dependency and reduce impact of international price fluctuations while simultaneously preserving environments.**
- **ENERGY USE PROJECTIONS HAVE TO BE MADE BASED ON RADICALLY DIFFERENT BASE RATHER THAN SIMPLE INCREMENTAL BASE.**
- **Blind implementation of imported ideas must be avoided to face same dilemma as WAPDA disintegration that resulted in loss of highly trained manpower & technologists and initiation of Circular Debt in the country.**

RECOMMENDATION FOR TARGET FOR 2060 RADICALLY DIFFERENT FROM IGCEP

PAKISTAN HAD INSTALLED ELECTRICITY CAPACITY OF 43,775 MW IN 2022	UK HAD INSTALLED ELECTRICITY GENERATION CAPACITY OF 75,800 MW IN 2022
PAKISTAN HAD POPULATION OF 231.3 MILLION IN 2022	UK HAD POPULATION OF 67.5 MILLIONS IN 2022
PAKISTAN'S POPULATION IS 3.4 TIMES UK	
PAKISTAN'S INSTALLED ELECTRICITY GENERATION CAPACITY SHOULD ALSO BE TECHNICALLY 3.4 TIMES OF UK IF AN AVERAGE PAKISTANI HAS TO CONSUME AS MUCH ELECTRICITY IN 2060 AS UK IN 2022	
THEREFORE TARGET FOR 2060 SHOULD BE 3.4 TIMES UK NOT ~60,000 MW AS IN PLANNED IGCEP	
230,000 MW	


GROWTH PROJECTED BASED ON IGCEP 2030 PLAN
IGCEP, 236,507
PLANNED ACGR=4.08%
MW
250,000
200,000
150,000
100,000
50,000
-
2022
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
2095
2100

THANK YOU