World Reserves and Production of Potash

Potash in Brazilian Agriculture Symposium
São Pedro – SP
September 22-24, 2004

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World Reserves and Production of Potash

- K present in most rocks and soils
- Economic sources …
  - ✓ sedimentary salt beds remaining from ancient inland seas (evaporite deposits)
  - ✓ salt lakes and natural brines
- Potash refers to a variety of K-bearing minerals

Common K Minerals

Mineral	Composition	K_2O, %
Sylvite	KCl	63.1
Sylvinite	KCl/NaCl mixture	~ 28.0
Carnallite	$KCl \cdot MgCl_2 \cdot 6H_2O$	17.0
Kainite	$4KCl \cdot 4MgSO_4 \cdot 11H_2O$	19.3
Langbeinite	$K_2SO_4 \cdot 2MgSO_4$	22.7
Polyhalite	$K_2SO_4 \cdot 2MgSO_4 \cdot 2CaSO_4 \cdot H_2O$	15.6
Niter	KNO_3	46.5

Common K Minerals

- Sylvite (KCl) … abundant in commercial deposits
- Sylvinite (KCl + NaCl) also common
- Hartsalz … ore deposits with SO_4 salts (kieserite [$MgSO_4$] or anhydrite [$CaSO_4$]) are limited … Europe
- Langbeinite occurs New Mexico and Ukraine

Potash Reserves

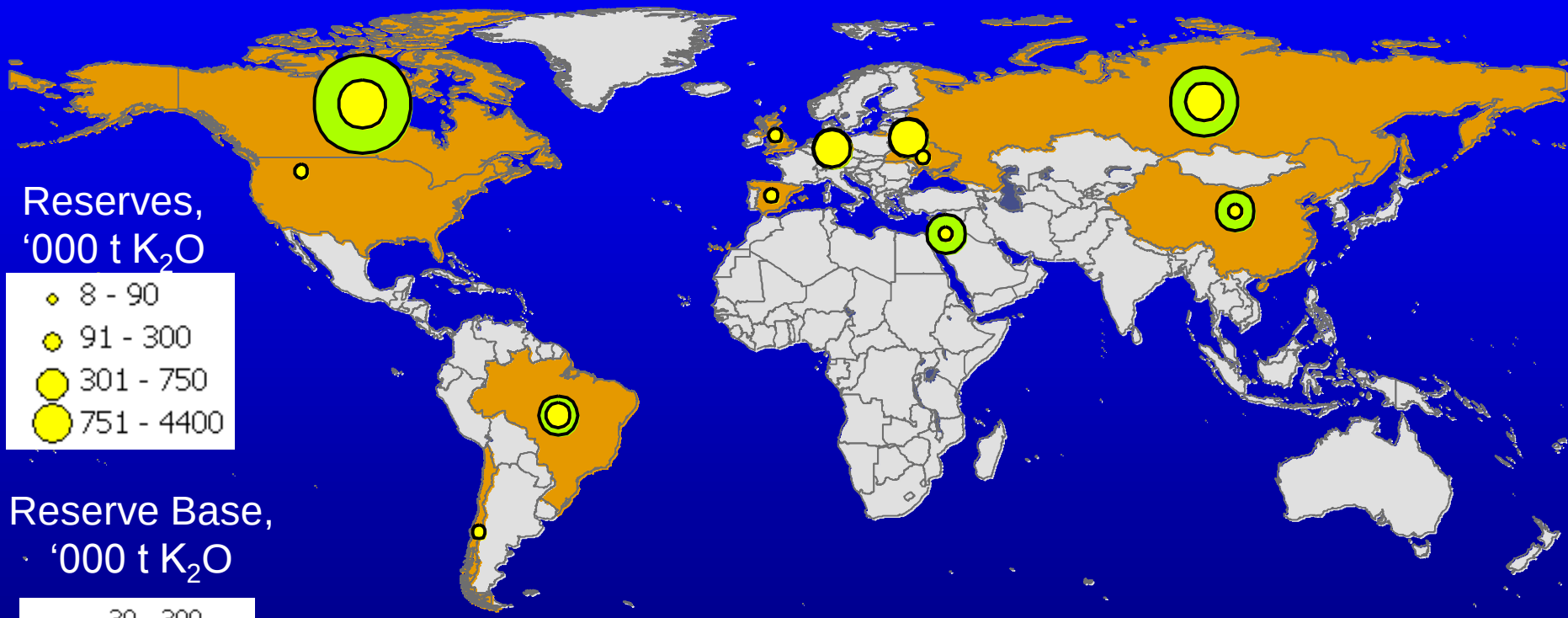
- ~100 large buried deposits + 100 brine deposits of commercial potential worldwide

- The world has an estimated 250 billion metric tons of K_2O resources

Potash Reserves

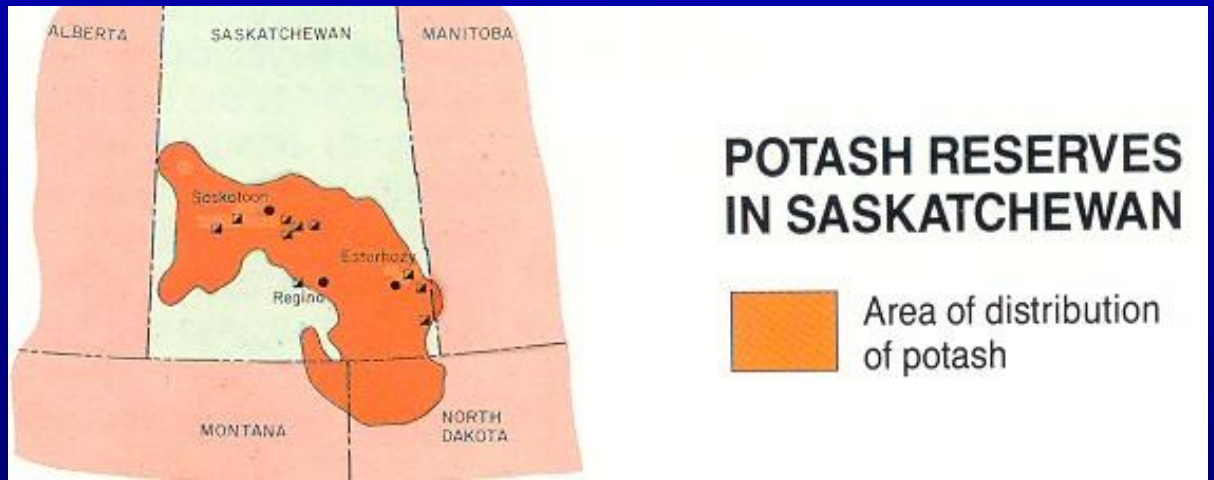
- Resources include proven, probable, and inferred reserves
  - ✓ Reserves – deposits of sufficient quantity and quality that are currently mined
  - ✓ Reserve base – reserves + deposits that are marginally economic or sub economic
- Global reserve estimated at 17 billion t K_2O … 8.3 billon t considered commercially exploitable.

Potash Reserves and Reserve Base



Potash Deposits – North America

- World's largest reserves occur in Saskatchewan
- Ore is exceptionally high grade (25-30% K_2O) at depths of 950-1,100 m increasing to > 3,500 m
- Uniform thickness (2.4-3 m) and mineralization and no structural deformations
- Sylvinite, some carnallite, and clay



Potash Deposits – FSU

- FSU has extensive proven reserves of K minerals … second only to the deposits in Saskatchewan
- Russia – Verkhnekamsk deposit in the Urals near Solikamsk
  - ✓ Potash depth at 75 to 450 m in 13 potentially minable beds ranging in thickness from 26 to 30 m (sylvinite) and 70 to 80 m (zone of sylvinite-carnallite).
  - ✓ Mined beds 1.2 to 6 m thick with 15% K_2O with 3 to 5% insolubles
- Belarus – Starobinsk deposit is 2nd largest in ore body in FSU near Soligorsk
  - ✓ 30 potash beds in 4 horizons. Most mining 350 to 620 m depth in second horizon (1.8 to 4.4 m thick)
  - ✓ Sylvinite ore averaging 11% K_2O and 5% insolubles

Potash Deposits – W. Europe

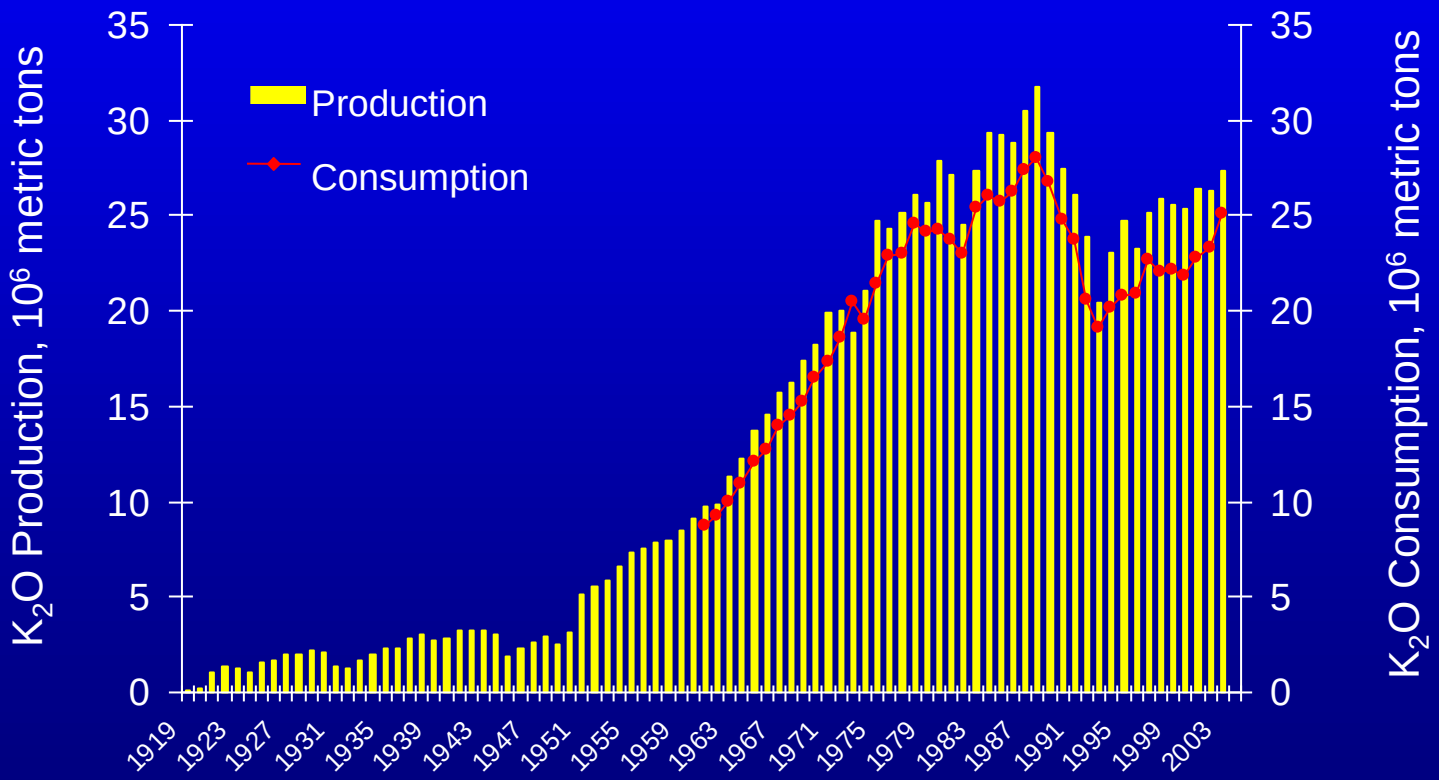
- Oldest deposits are the Hessen and Thüringen beds in southern Germany
  - ✓ contain 15 to 20% sylvite, kieserite, and carnallite (~10% K_2O)
  - ✓ Beds are relatively flat-lying, but also folding, with some barren zones, sudden thickness changes, etc. making mining difficult
- Also carnallite and kieserite deposits in central Germany and sylvite and carnallite in northern Germany
- Sylvite deposits in England and sylvinite in Spain

Potash Deposits

- Middle East – K extracted from Dead Sea
  - ✓ contains an estimated 1 billion t KCl
- Latin America
  - ✓ sylvinite and carnallite in the Sergipe basin in Brazil
  - ✓ KNO_3 in Chile in Atacama Desert (est. 1 billion t $NaNO_3$ and 100 million t KNO_3) and Salar de Atacama, a high-attitude dry lake (brine est. at 120 million t KCl and 80 million t K_2SO_4
- Asia
  - ✓ Carnallite and K-bearing brines in Qinghai Province
- Undeveloped Deposits
  - ✓ Thailand, Argentina, Amazon Basin in Brazil, Morocco, Poland, and additional deposits in the FSU

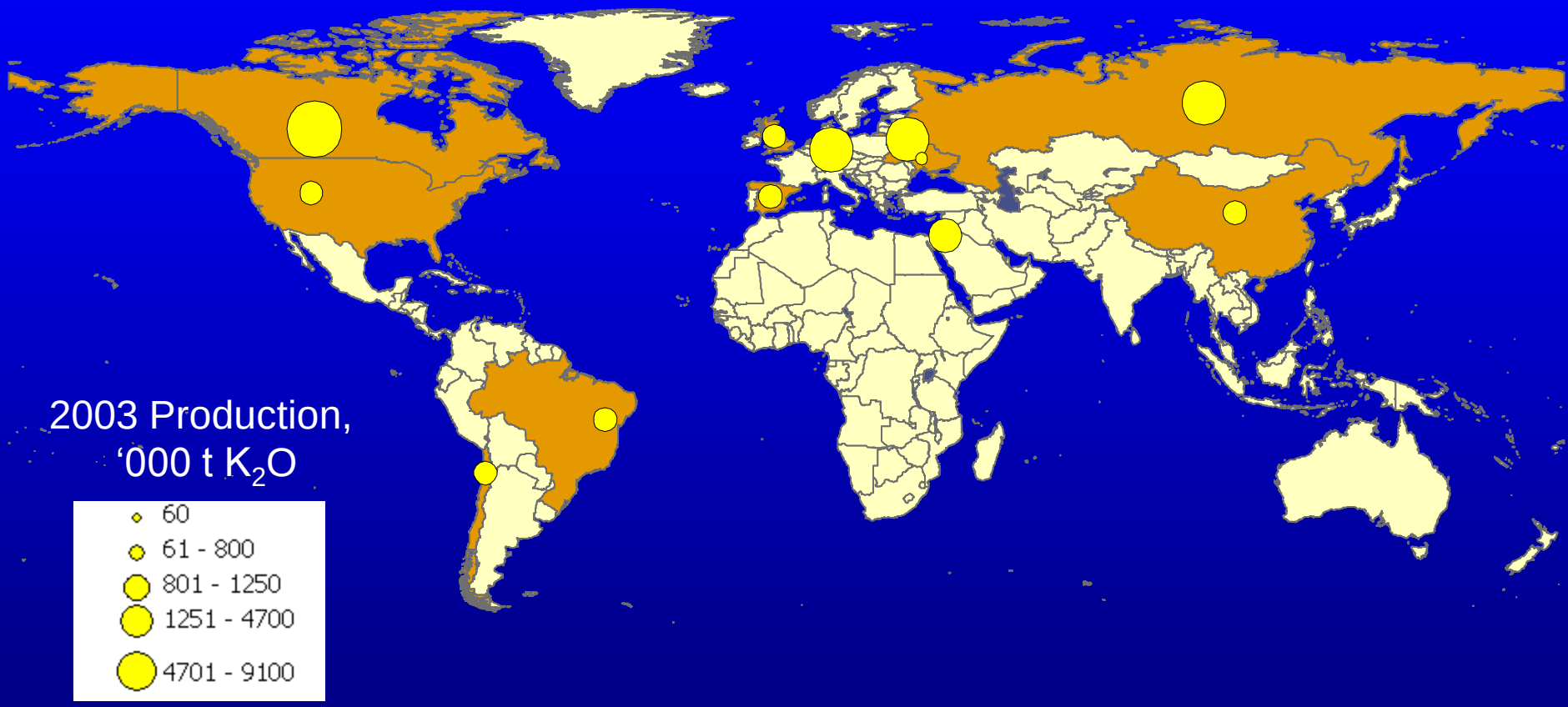
World Potash Production and Consumption

(Million metric tons K_2O)

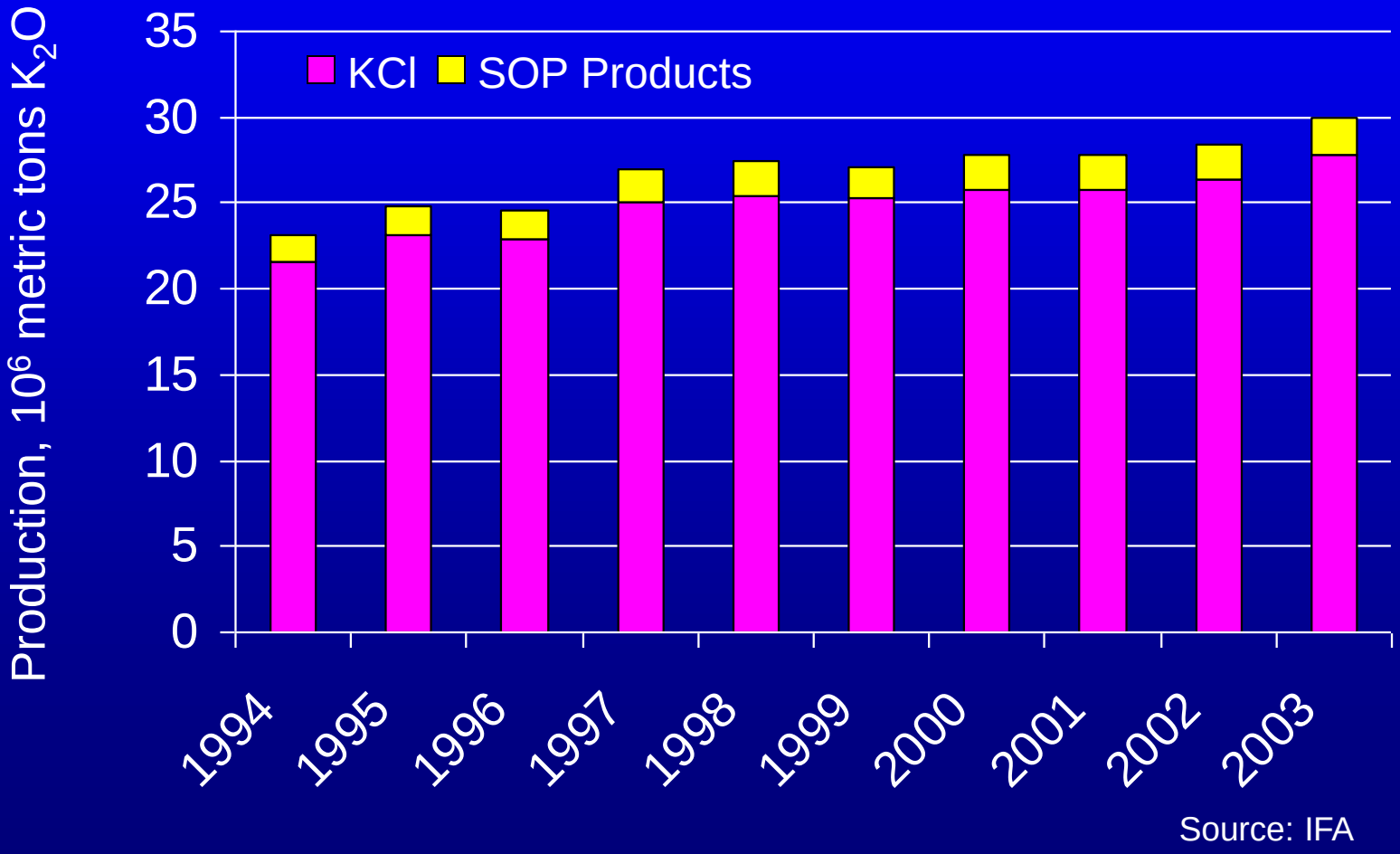


Source: USGS, FAO, IFA

Location of Potash Producers

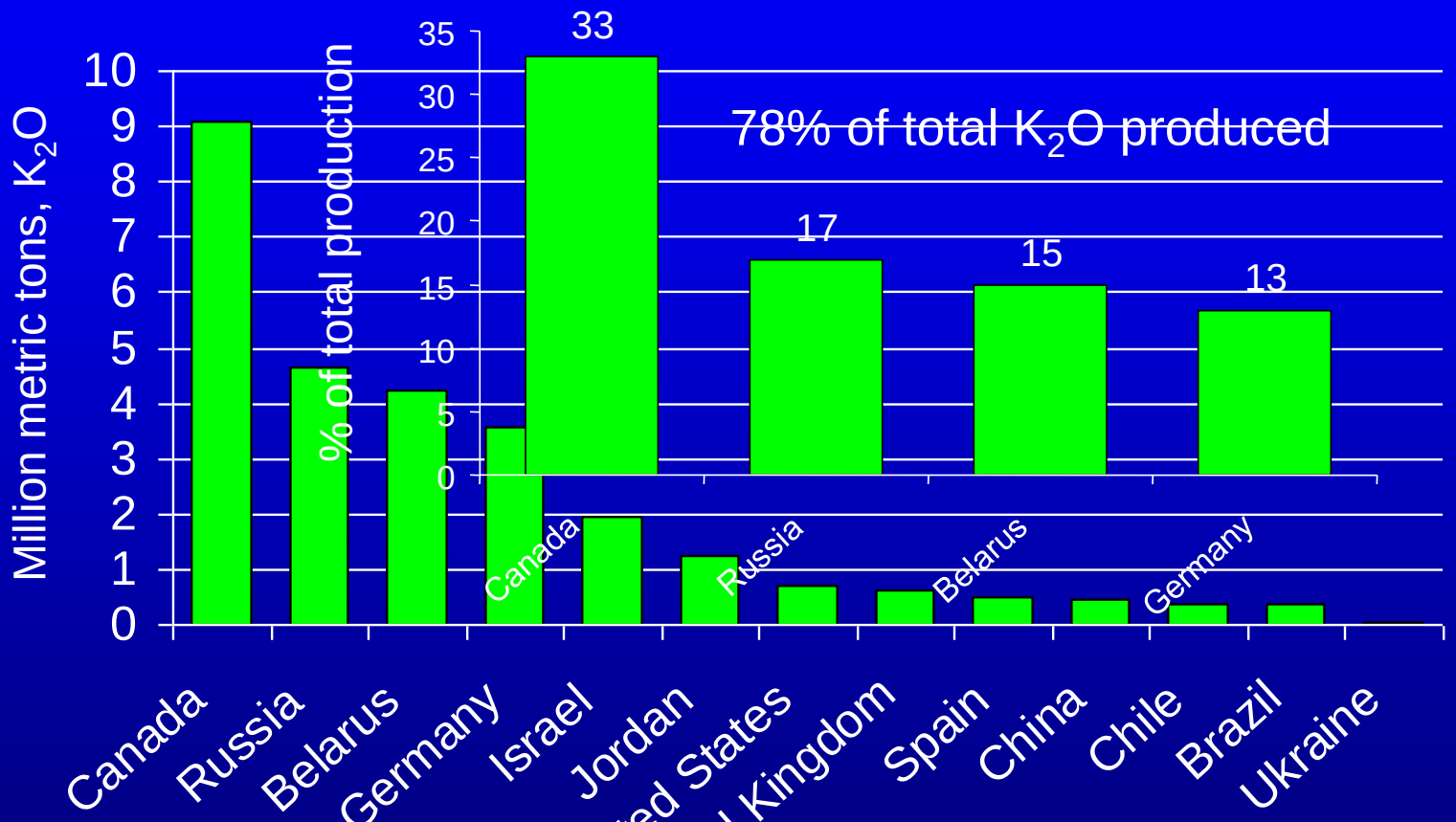


Production of KCl and K_2SO_4 Products



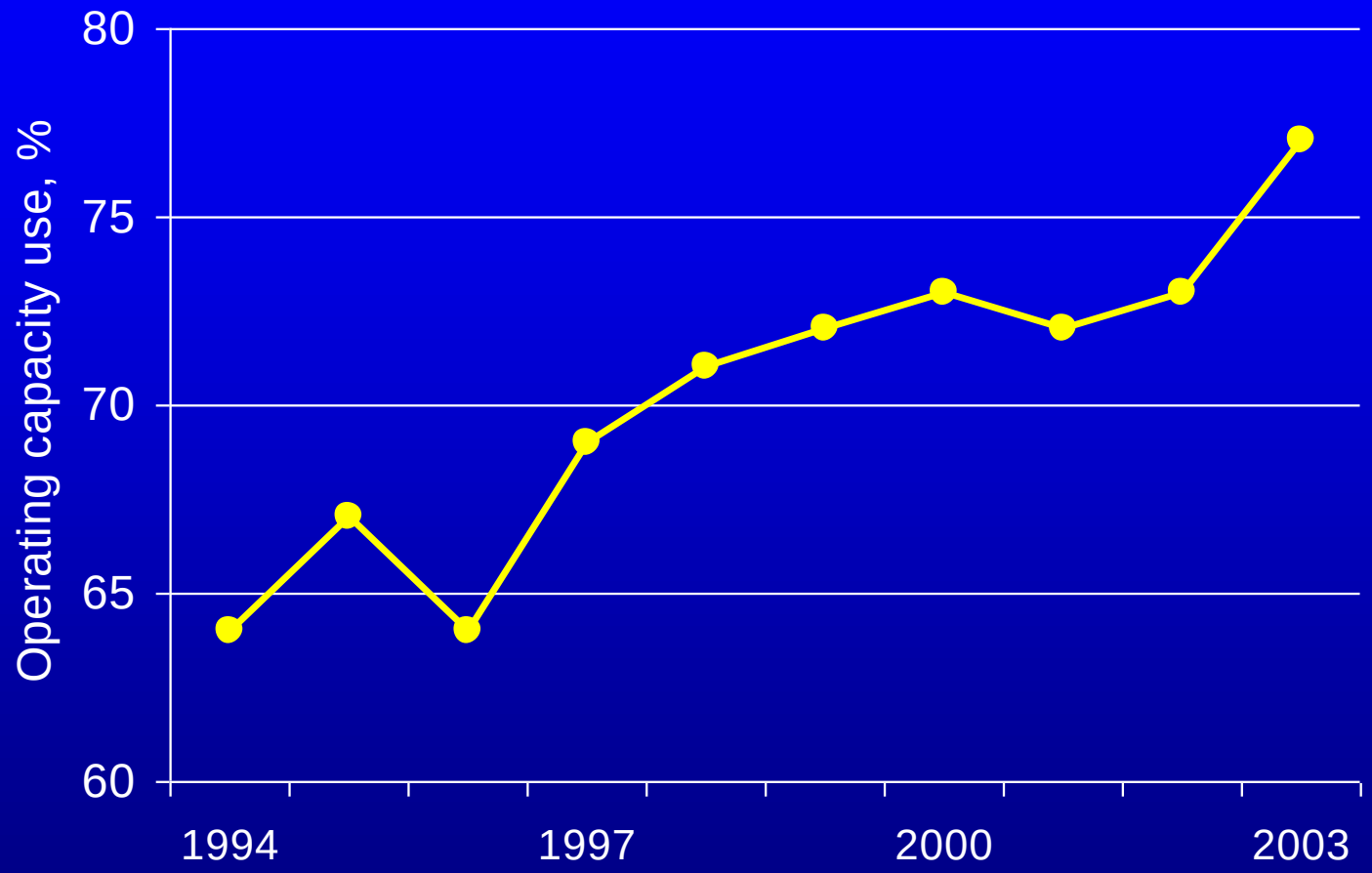
Source: IFA

World Mine Production 2003



Source: IFA

World Operating Capacity
(1994 – 2003)

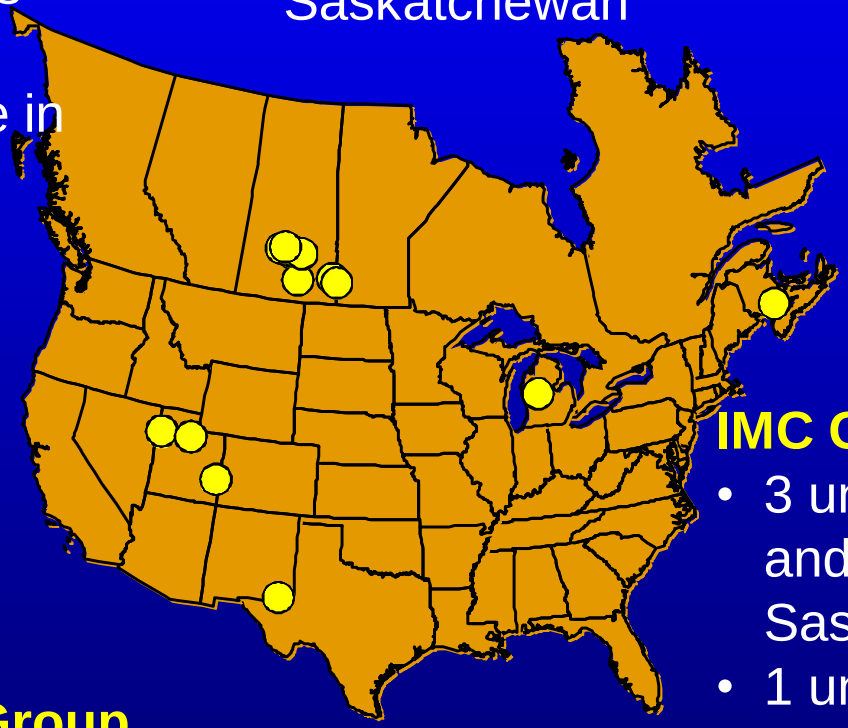


Source: IFA and Natural Resources Canada

North America

PotashCorp
- 5 underground mines and 2 solution mines in Saskatchewan
- 1 underground mine in New Brunswick

Agrium
- 1 underground mine in Saskatchewan



Intrepid Mining
- 2 underground mines in New Mexico
- A brine operation and solution mine in Utah

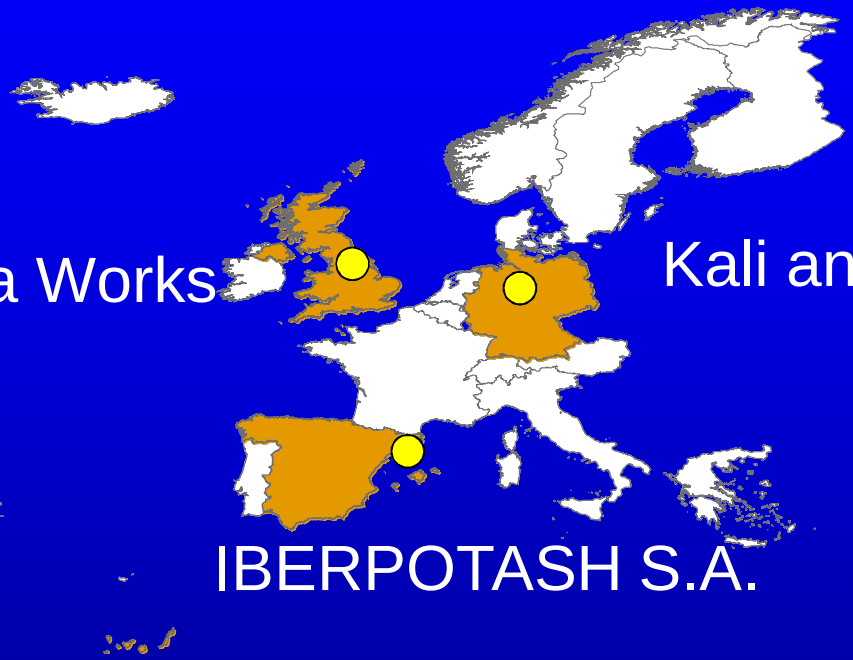
IMC Global
- 3 underground mines and 1 solution mine in Saskatchewan
- 1 underground mine in New Mexico and a solution mine in Michigan

Compass Minerals Group
- 1 brine operation in Utah

Eastern Europe

- Russia and Belarus are the 2nd and 3rd leading producers … 17% and 15% of 2003 global production
- 2003 Operating capacity:
  - ✓ Russia – 71% (63% in 1999)
  - ✓ Belarus – 78% (66% in 1999)

Western Europe



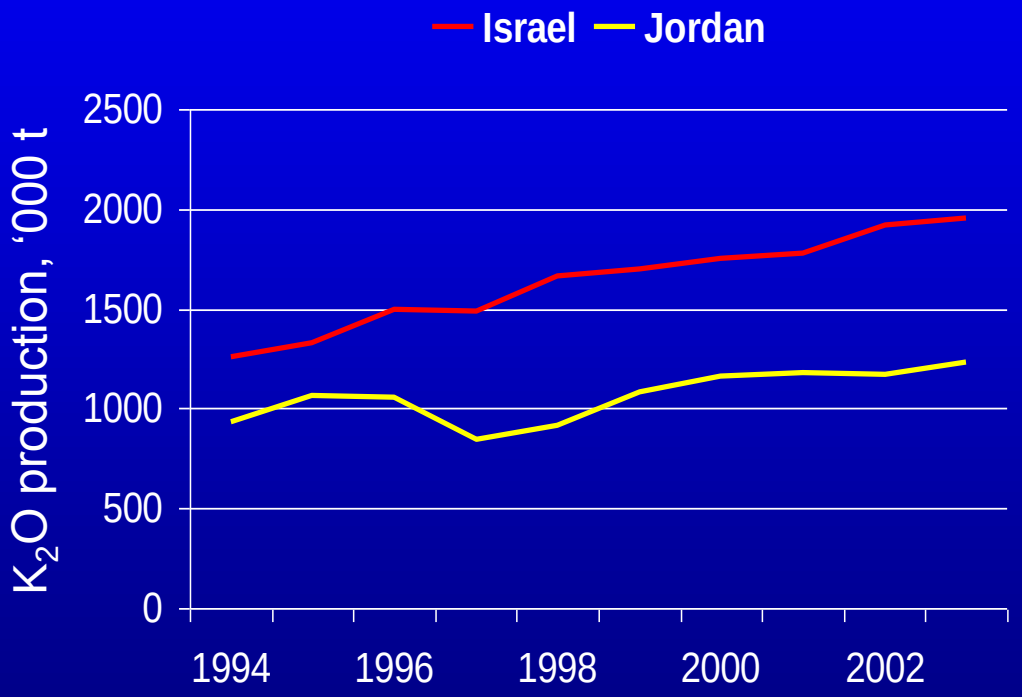
- Western Europe …17% of world production in 2003
  - ✓ 13% from Germany

K_2O Production, '000 metric t

	1994	2000	2003
France	870	321	0
Germany	3,286	3,409	3,565
Spain	684	522	506
UK	580	601	621

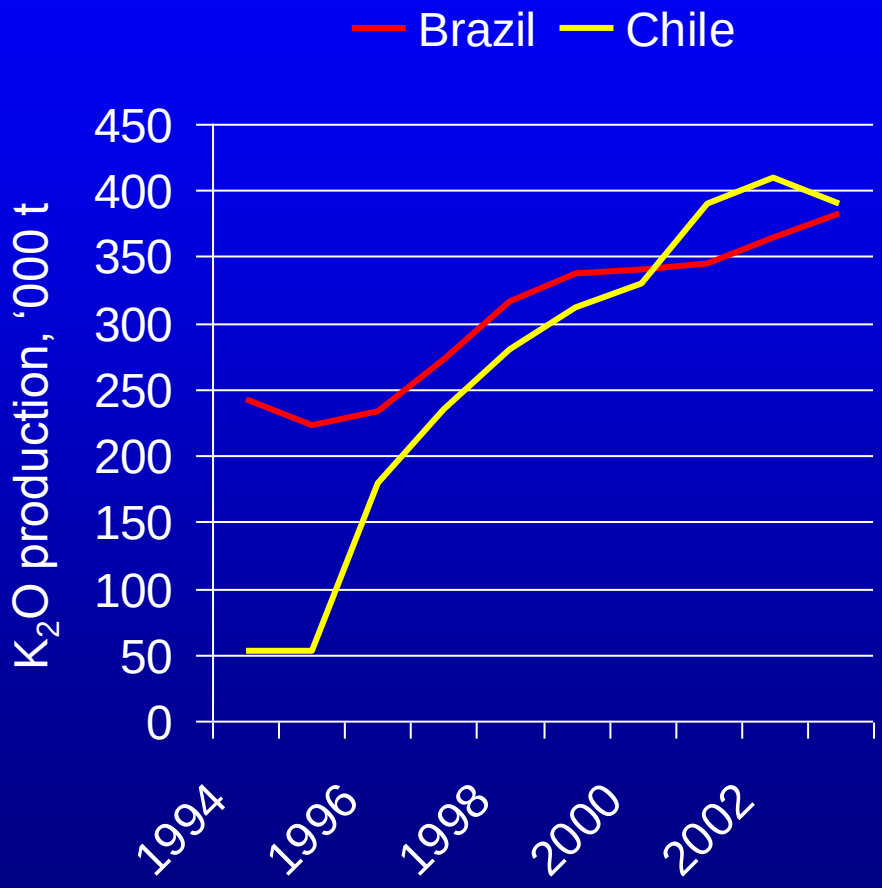
Middle East

- Israel and Jordon represented 11% of world production in 2003
- Arab Potash, the only producer in Jordan is being privatized
- Dead Sea Works (DSW), with production in Israel and recent acquisitions in Spain and UK is the world's 5th largest producer



Latin America

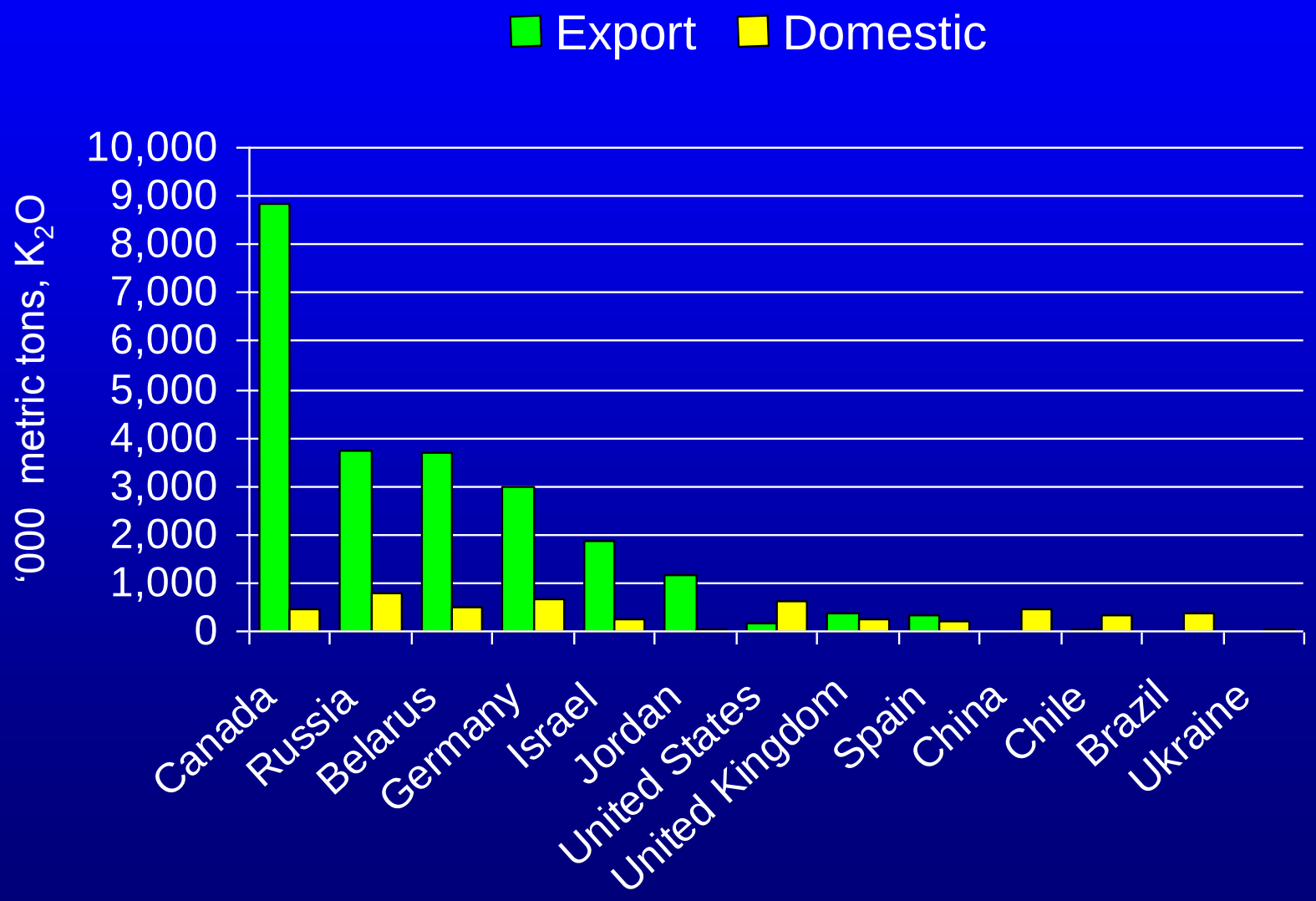
- Produced 3% of world's K_2O in 2003
- Companhia Vale do Rio Doce (CVRD) … one mine in Sergipe
- Sociedad Quimica y Minera de Chile S.A. (SQM) in northern Chile produces KCl/SOP by solar evaporation and KNO_3 from $NaNO_3$
- Both producing close to capacity … CVRD plans to increase capacity



Asia

- China is a small producer, but production has been increasing ~8% per year since 1994
  - ✓ est. 440,000 t K_2O in 2003
- KCl by solar evaporation around Lake Qarhan in Qinghai Province
  - ✓ 1 million t project under development by Qinghai Yanhu Potash Fertilizer … 0.3 million t in 2003/04 and 0.7 million t by 2006/07

Potash Trade

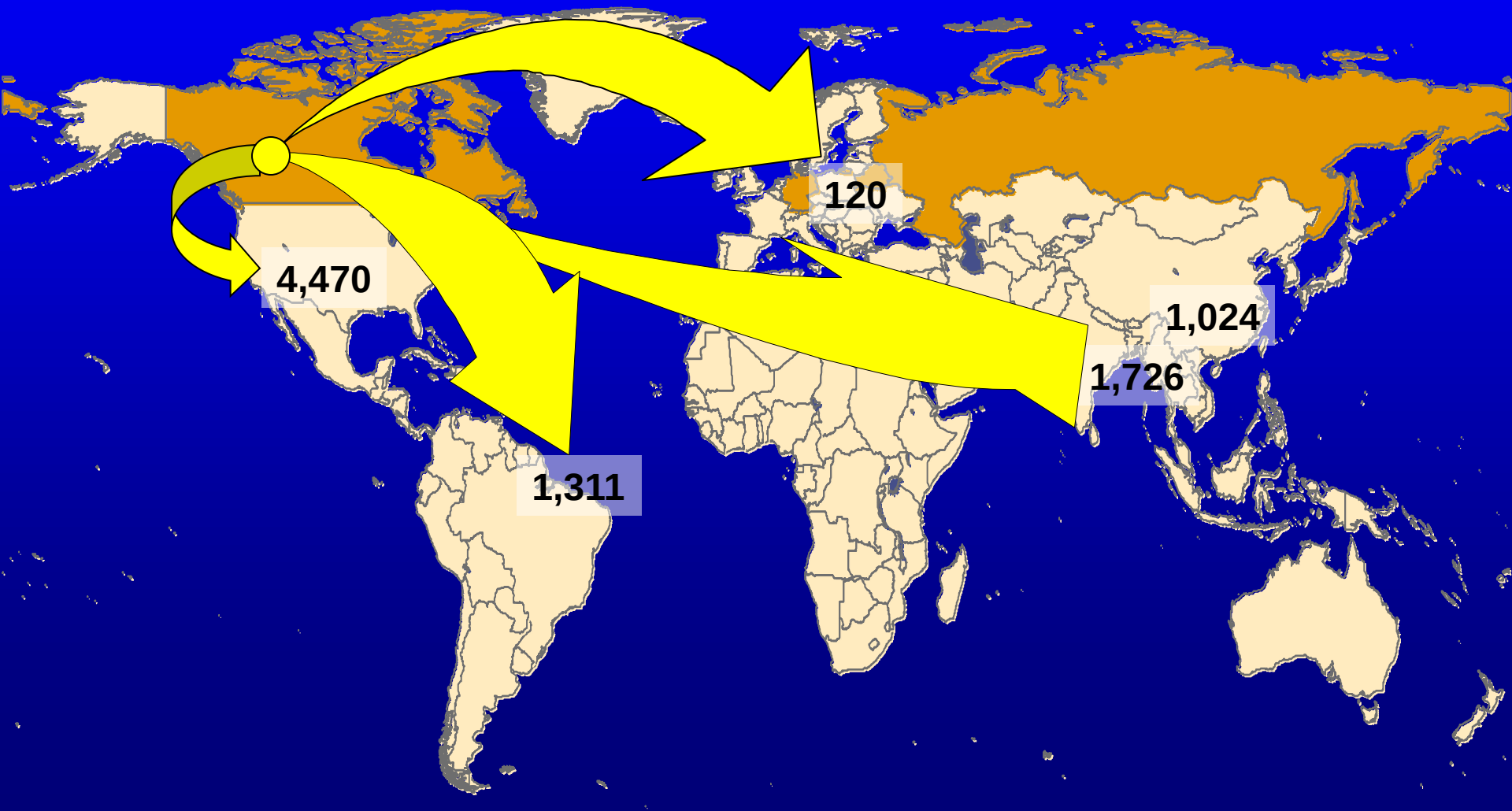


Potash Trade

- Grown ~ 3% for two-thirds of potash imports in 2003 annually for the last 10 years
- 4 countries accounted for two-thirds of imports
  - ✓ U.S. 21%
  - ✓ Brazil 16 %
  - ✓ China 15%
  - ✓ India 7%
- U.S. market is mostly mature … modest future growth expected
- Markets in Asia and Latin America are rising and are expected to continue in the future

2003 World Trade
('000 metric tons K_2O)

From Canada



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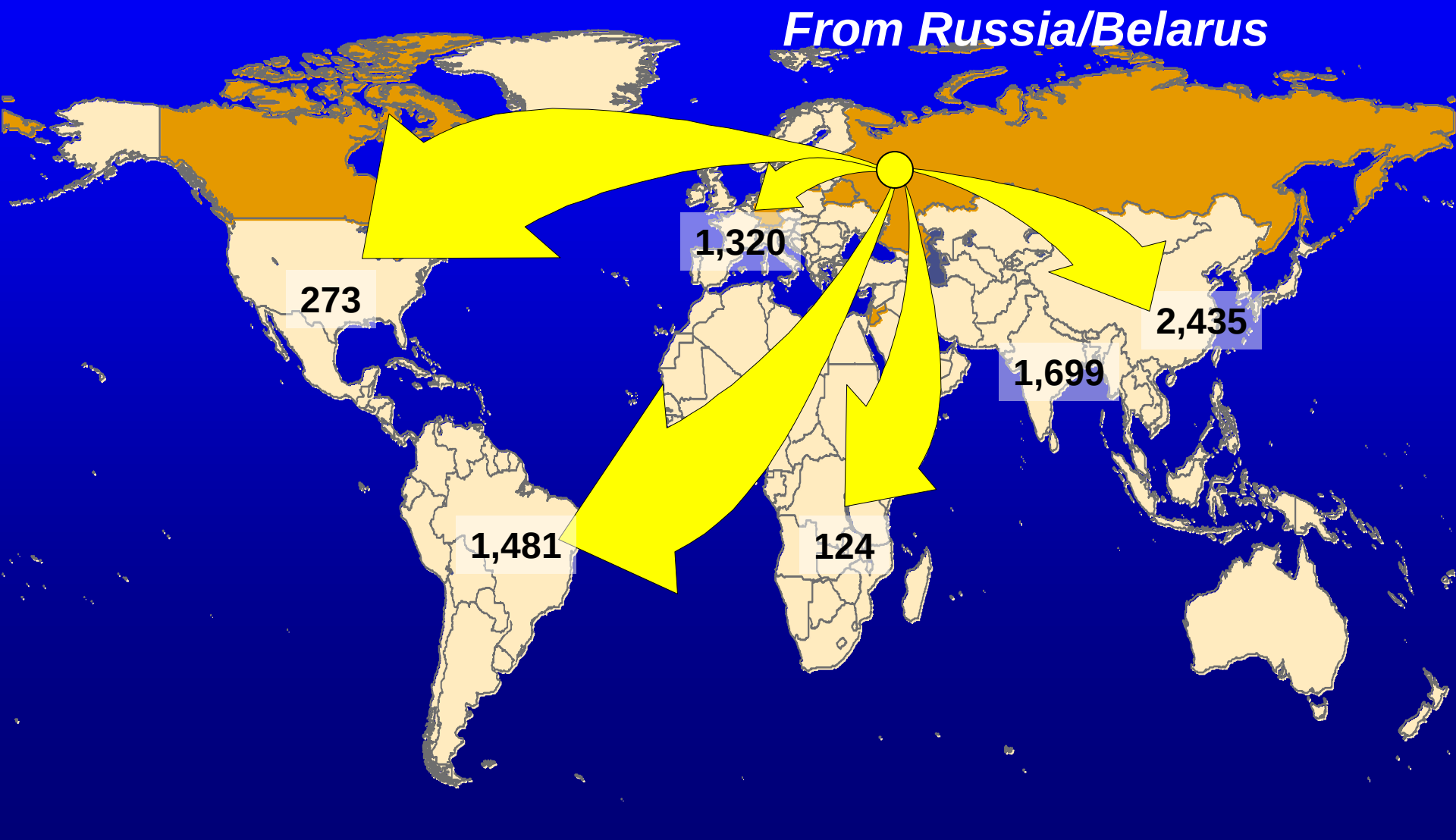

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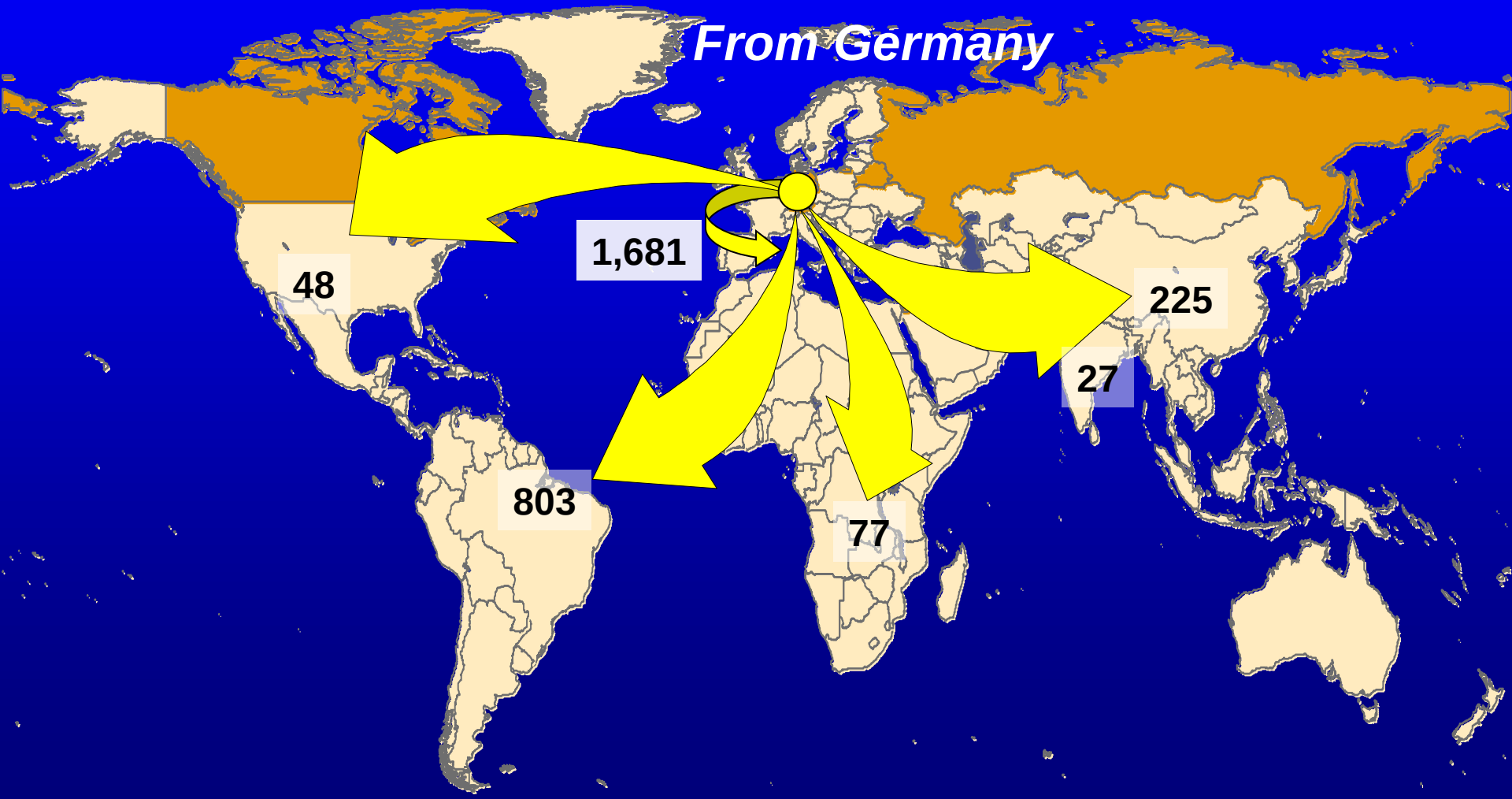

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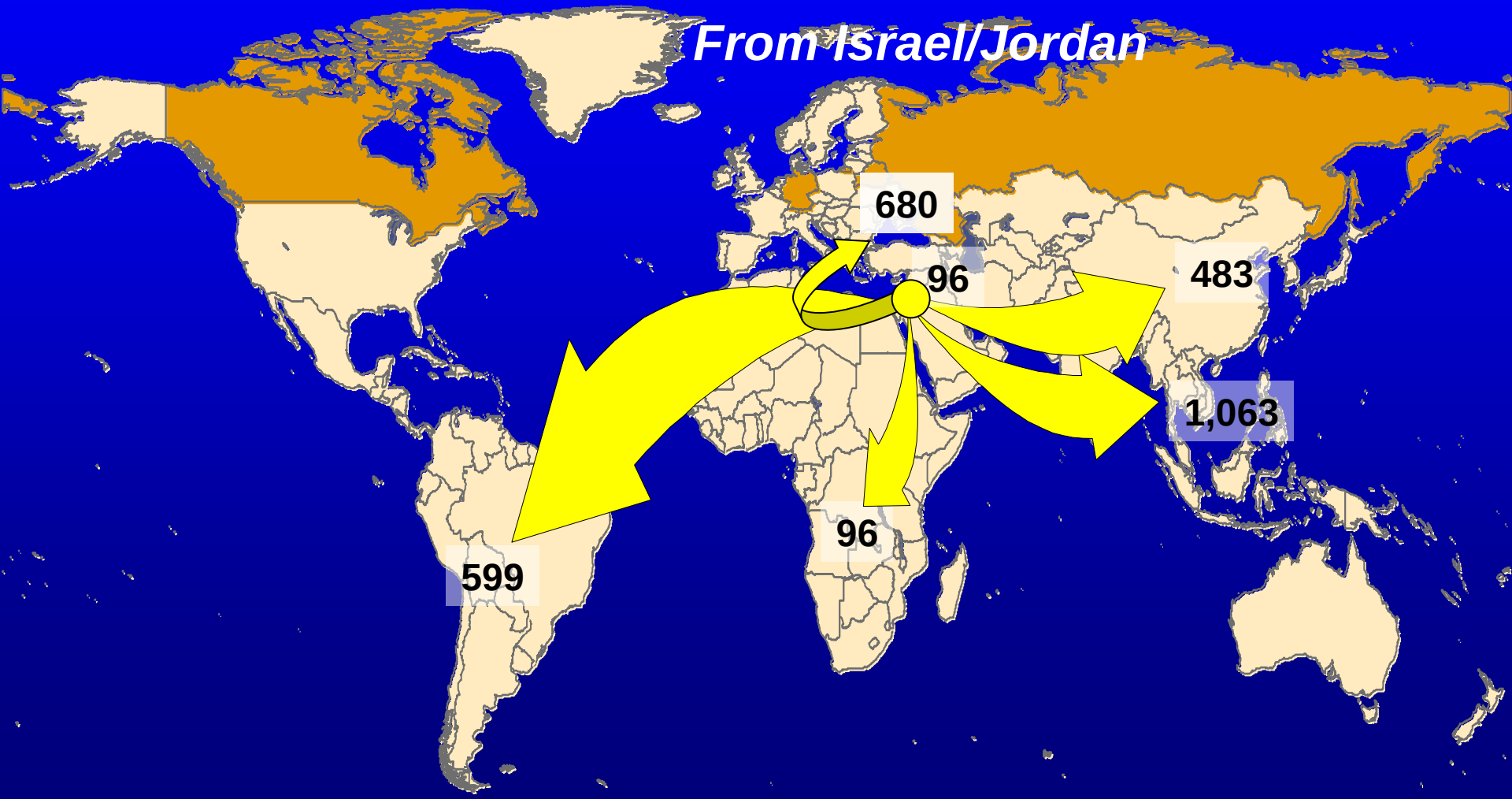
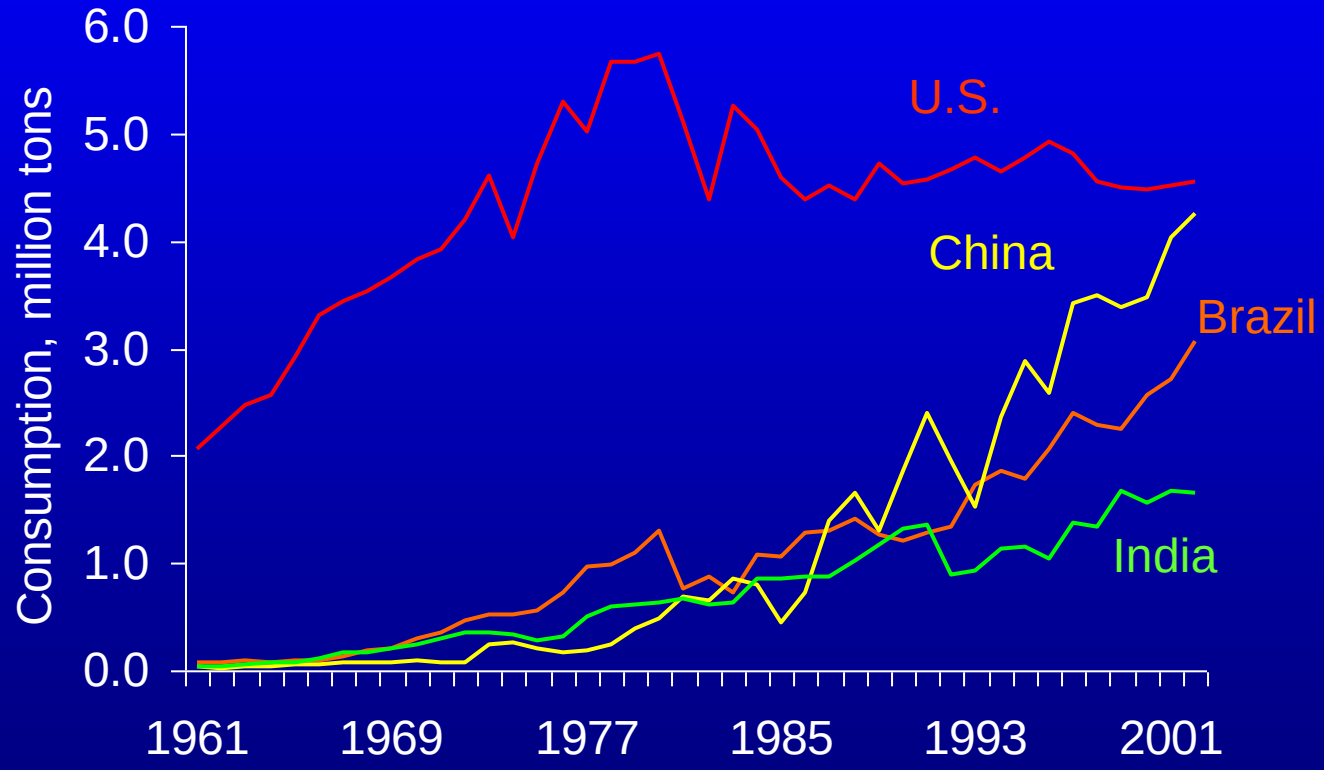


Concluding Remarks

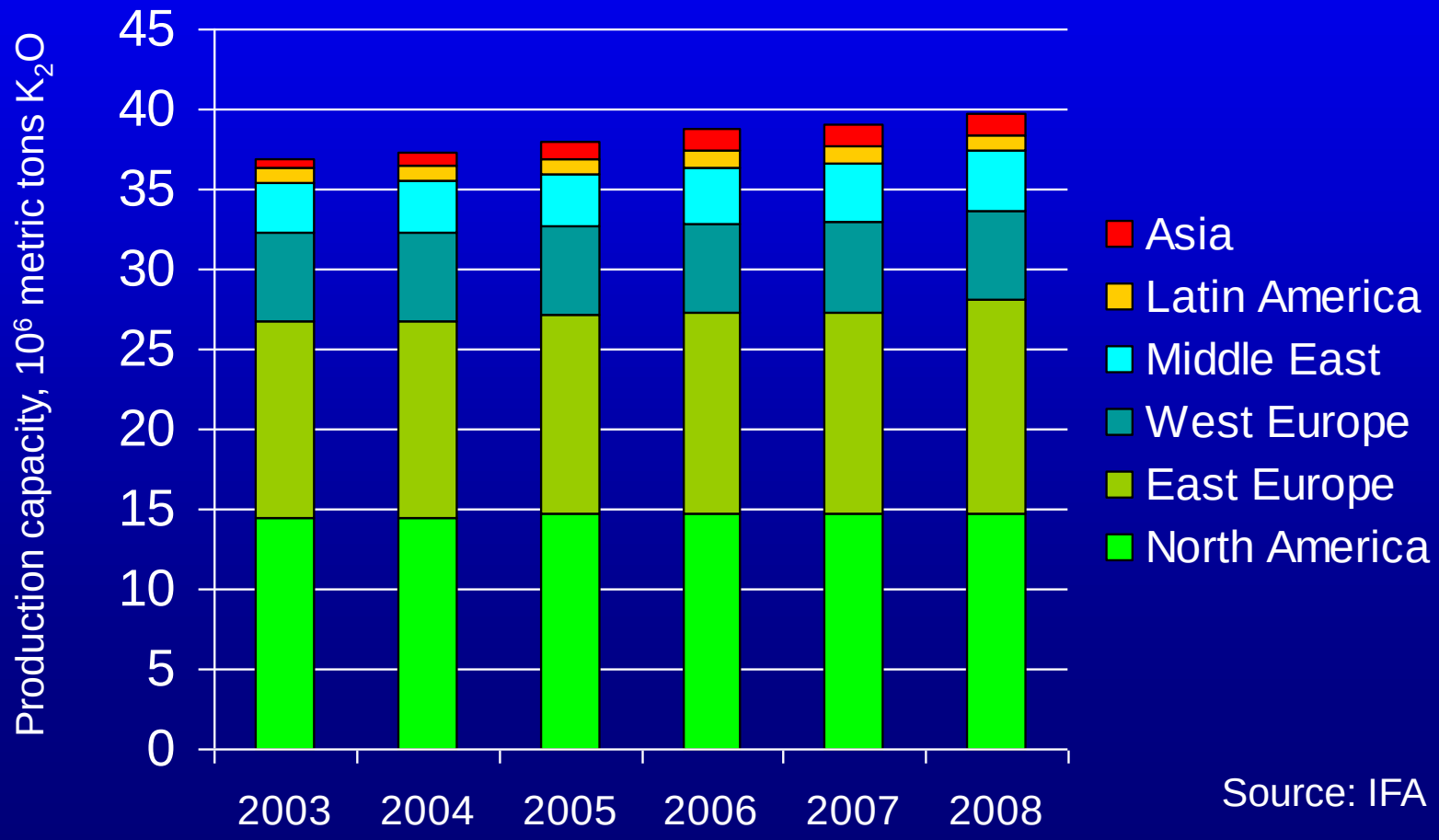
Potash consumption



Source: FAO

Concluding Remarks

Potash Production Capacity



Source: IFA

Concluding Remarks

- Increasing potash consumption in Brazil, India, and China
  - ✓ Global K_2O consumption is ~24 million t and forecast to reach 29 million t in next 5 years
- Potash industry has been operating in a surplus
  - ✓ Exporting countries … 70 to 75% of capacity
  - ✓ Production capacity is expected to grow ~8% in next 4 to 5 years
  - ✓ 70% of new growth in exporting countries and the balance in China and Brazil

Concluding Remarks

- At present levels of production (~ 28 million t K_2O per year) and with current/planned capacity, the industry can easily meet future demand
- At present levels of production, minable reserves and the known reserve base are sufficient to supply potash for at least 600 years
  - ✓ Considering known resources … there is sufficient potash to meet demand for thousands of years

Thank You