



UNSW
THE UNIVERSITY OF NEW SOUTH WALES



THE AUSTRALIAN CRC FOR
RENEWABLE ENERGY LTD

Fundamentals of
Electricity Industry Restructuring
*Australia's
Restructured Electricity Industry*

Hugh Outred

University of New South Wales

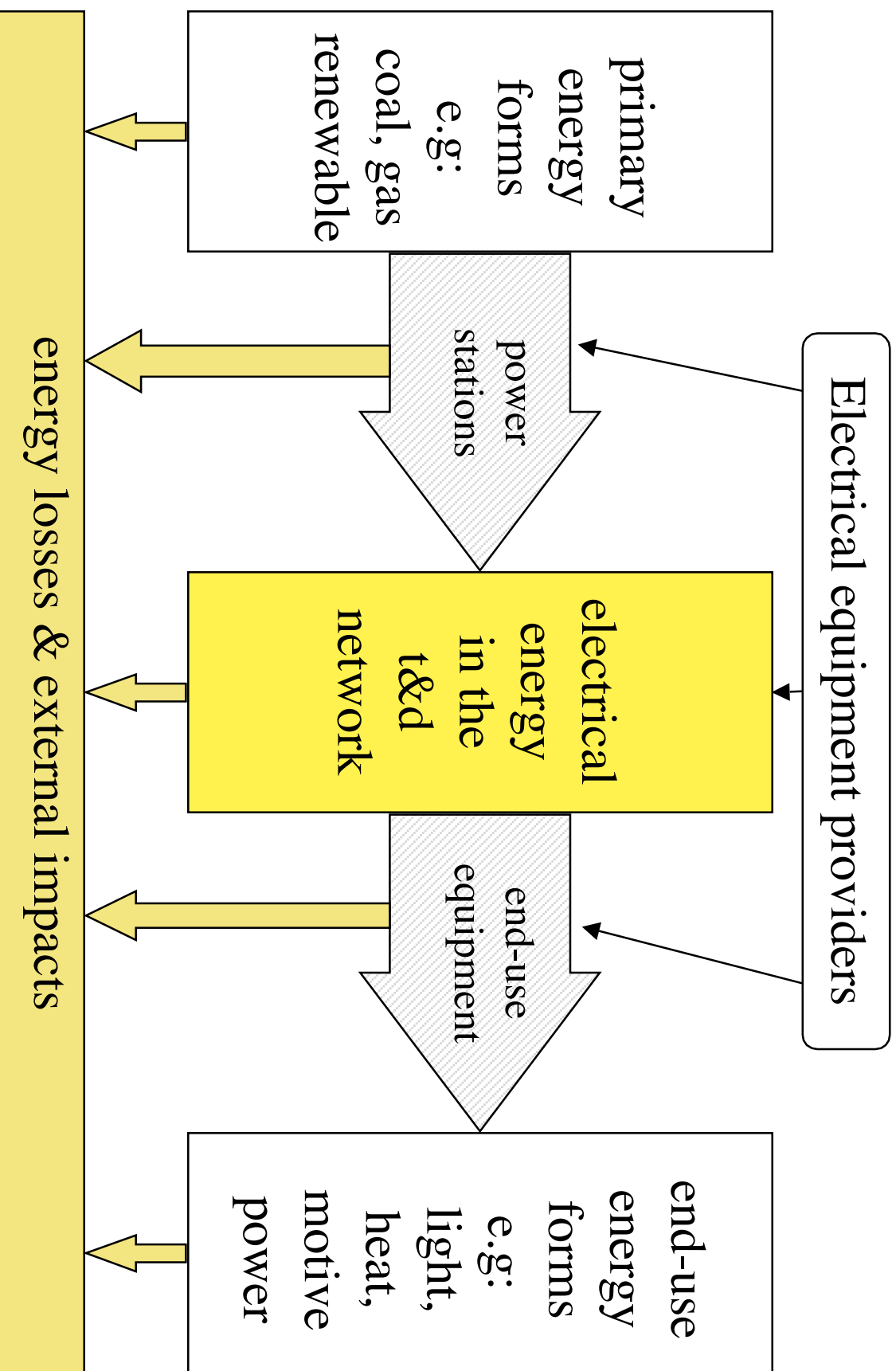
Email: h.outred@unsw.edu.au

Tel: 0414 385 240

Outline

- Physical properties of the Electricity Industry
- Objectives & implementation of Electricity Industry Restructuring
- Structure and key parameters of the Australian Electricity Industry

The electricity industry conversion chain



Key issues for the electricity industry

- Part of the stationary energy sector:
 - In competition with other energy vectors
- Significant externalities:
 - Environmental & social
 - Has become an ‘essential good’
- Characteristics of electricity:
 - A high quality, secondary energy form:
 - Expensive but flexible to make, transport & use
 - Specific physical properties

- **Specific properties of electrical energy:**
 - No cost-effective storage of electricity
 - Instantaneous transmission & distribution
 - Energy flows according to network laws:
 - From all generators to all consumers
- **Implications:**
 - Supply & demand must balance at all times:
 - Active demand-side participation important
 - Electrical continuum - power station to end-use
 - Cannot assign energy from a particular power station to a particular consumer:
 - ‘pool’ rather than ‘bilateral’ physical trade
 - **Generator, Network & End-use equipment roles not clearly separable**

Objectives for industry restructuring

- Improve economic efficiency by introducing competition & facilitating new entry:
 - Assumes liquid markets & sound legal environment
- Enhance accountability to end-users & society through ‘customer choice’
 - Assumes “informed” decision making by end-users
- Implement a market-based approach to social & environmental externalities:
 - Assumes political will to regulate non-monetary impacts
- Release government funds by asset sales:
 - Creates a moral hazard for politicians

Transitions in structure & role

(these may take decades to complete)

Starting point:

- Monopoly generation
- Monopoly network
- Passive consumers
- Regulated tariffs
- Externality controls
- Intrusive regulation

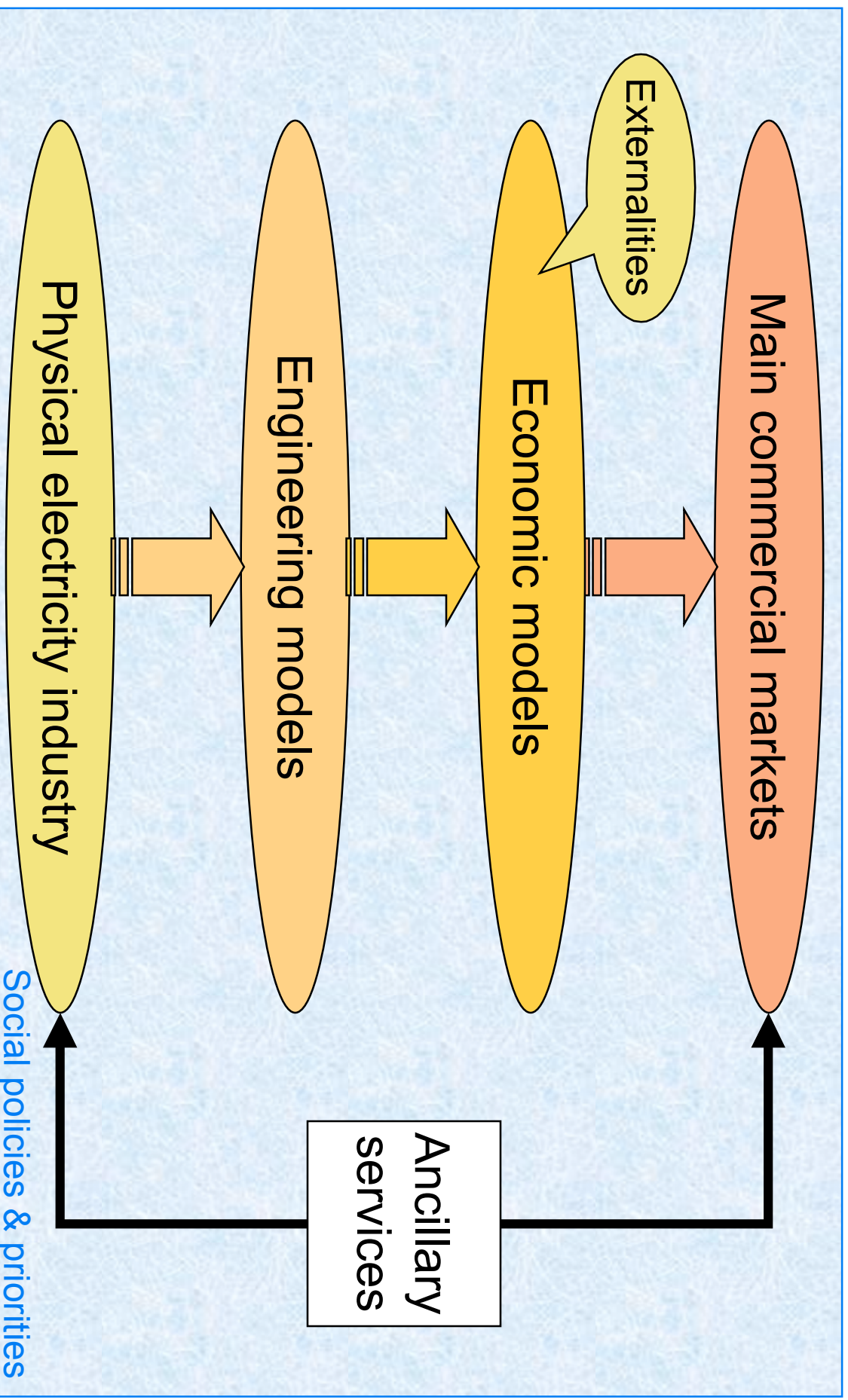
End point:

- Competitive generation
- Contestable network
- Active consumers
- Risk-sharing contracts
- Externality values
- Incentive regulation

Challenges in Electricity Industry Restructuring

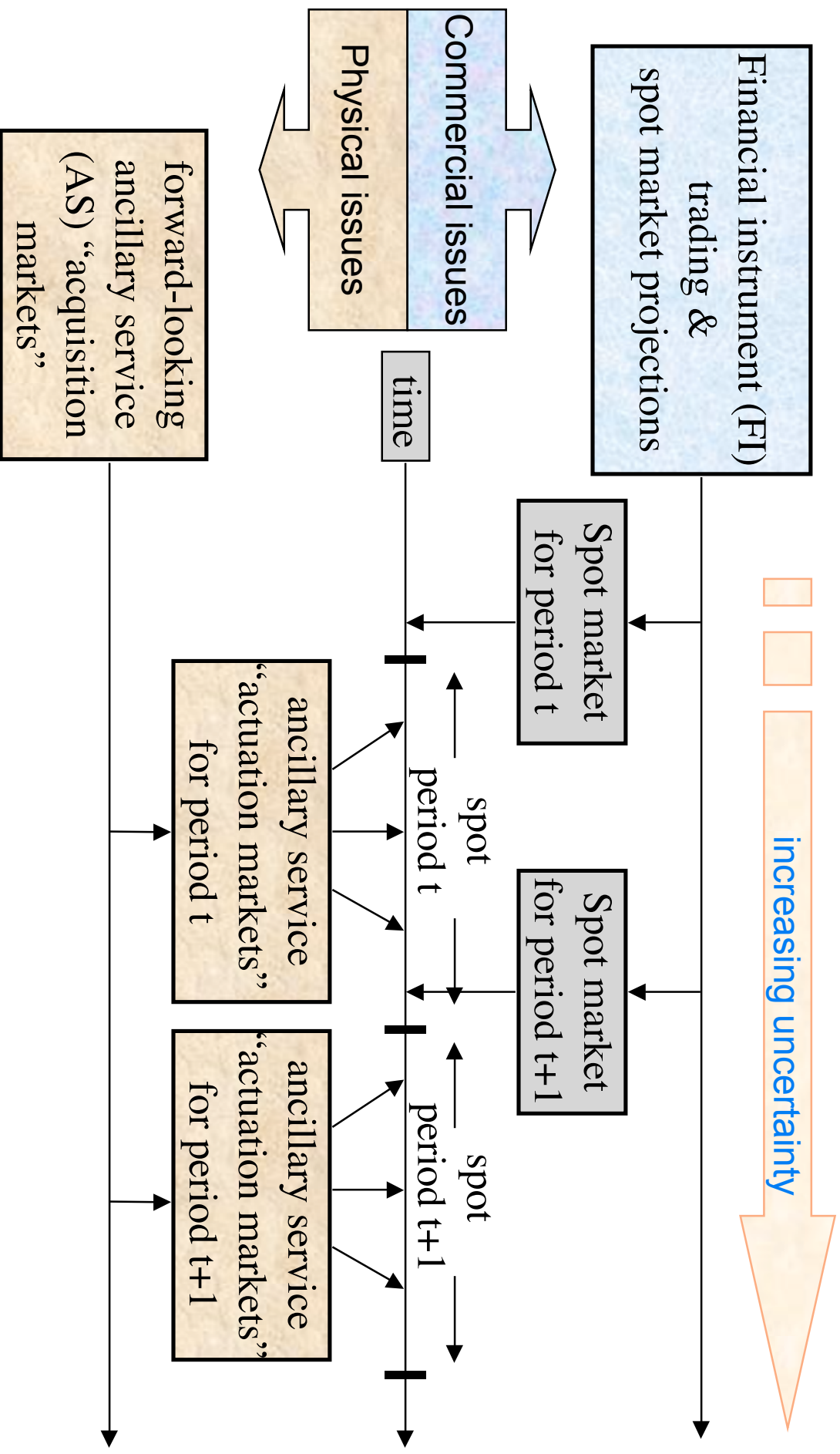
- **Nature of electrical energy:**
 - Ephemeral, due to lack of cost-effective storage:
 - Fragility of quality of supply prevents full deregulation
 - Fungible across an unconstrained network:
 - Shared responsibility for supply availability & quality, network losses and operating constraints
 - Large & small, supply & demand sides not separable
 - Essential good (equity & commercial issues):
 - Politics of retail prices, supply availability & quality
- **Environmental impact:**
 - GH emissions, acid rain & nuclear wastes

Trading in electricity:- an **abstraction** from reality

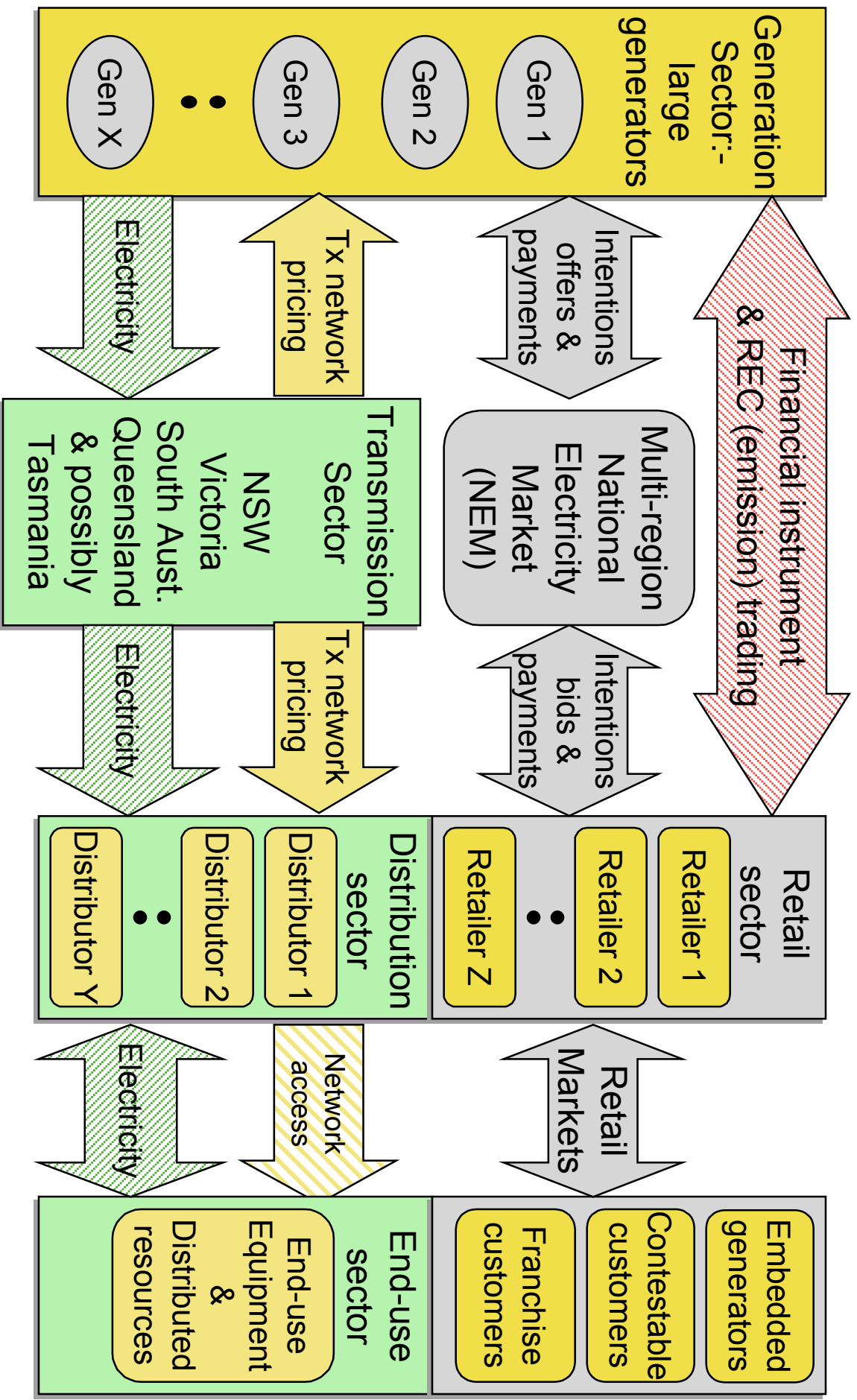


Timeline for electricity trading

(requires active demand-side participation)



Electricity industry structure in SE Australia



States participating in the National Electricity Market (NEM)

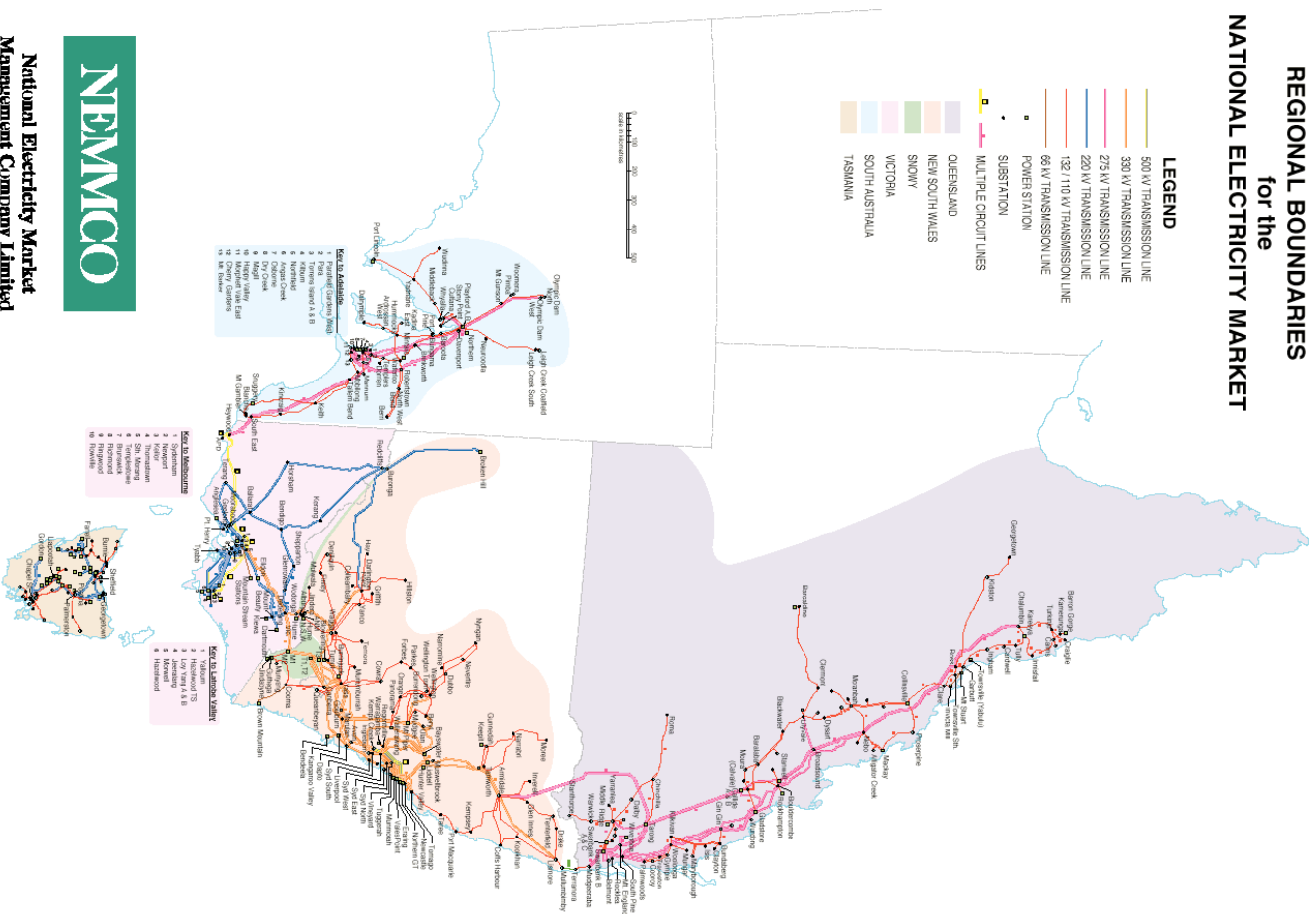
- Queensland
- New South Wales & ACT
- Victoria
- South Australia
- Tasmania (on connection to the mainland)

NEM regions are indicated, and their boundaries need not be on state borders (e.g. two regions in NSW)

Queensland was expected to have 3 NEM regions, but transmission augmentation is removing the associated flow constraints

© H. Outhred 2002

REGIONAL BOUNDARIES for the NATIONAL ELECTRICITY MARKET



Australian Renewable Electricity Industry #12

COAG restructuring process

- 1990-2:
 - COAG agreed to consider reform (1990)
 - Industry Commission report (1991):
 - Poor investment decisions:- excess capacity
 - Excessive staff levels
 - Cross subsidies in electricity pricing
 - Recommended a competitive 'national grid'
 - National Grid Management Council formed:
 - Implement COAG policy on electricity restructuring
 - National Grid Protocol, First Issue (Dec 1992)

COAG restructuring process

- 1993
 - NGMC ‘Paper trial’:
 - Interconnected regional pools:
 - Including network losses & interconnector constraints
 - Centralised commitment, capacity contracts, CFDs
- 1994-98:
 - Development of National Electricity Code
 - NEM1 commenced May 1997 (NSW & Victoria)
 - Queensland market commenced Nov 97
 - NEM commenced 13 December 1998

NSW restructuring process

- 1992-93:
 - Government Pricing Tribunal (GPT) created:
 - Independent regulator (later to become IPART)
 - Pacific Power commences internal ELEX market:
 - Thermal generators bid one day ahead:
 - start-up price, fixed run price, 4 incremental prices
 - Half-hourly prices for a single node pool set one day ahead
 - GPT made first determination of the BST (1993)

NSW restructuring process

- 1994-97:
 - Pacific Power restructured & corporatised to give:
 - Three generation companies
 - One transmission company
 - NSW Electricity Supply Act, 1995:
 - Wholesale electricity market (commenced May '96)
 - Restructuring of distribution industry:
 - Six distributor/retailers formed by merging 25 distributors (currently under review)
 - Licence-based regulation for distributors & retailers
 - NEM1 commenced May 1997
- Savings of ~\$1000 M/yr, 1993-1997

Victorian restructuring process

- 1992:
 - SECV develops VicPool 1 & 2 proposals:
 - based on bilateral contracting
 - New Victorian government instigates restructuring
- 1993:
 - SECV split into:
 - Generation
 - Transmission
 - Distribution /Retail
 - ESI Reform Unit created

Victorian restructuring process (ctd)

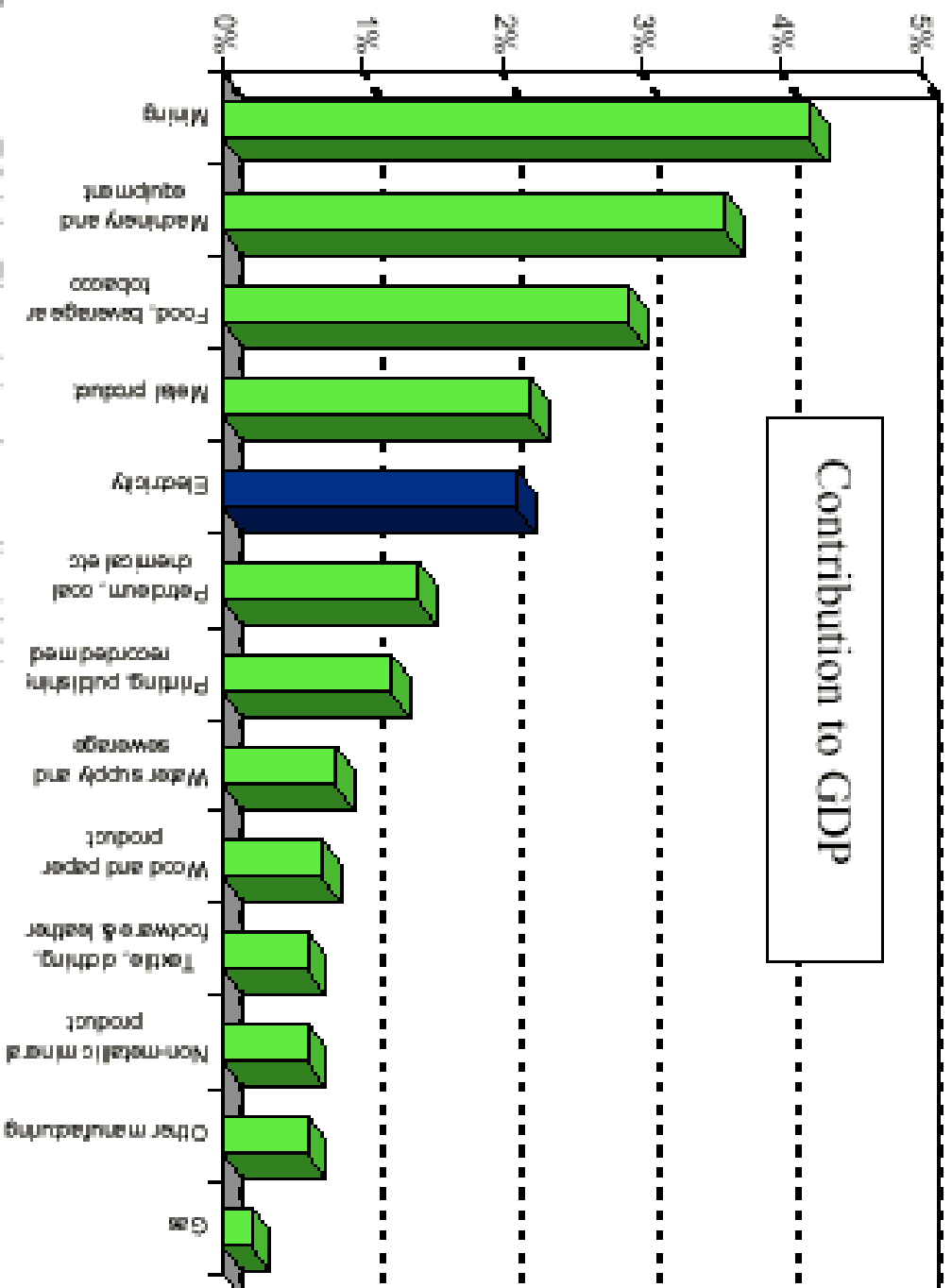
- 1994-97:
 - Office of Regulator-General created (1994):
 - Independent regulator
 - VicPool (evolving design, 1994-1997)
 - half-hour prices initially set one week ahead
 - Five distributors created (1994)
 - Transmission Split into (1994):
 - Power Net Victoria and Victorian Power Exchange
 - Five generation businesses created (1995)
 - Asset sales (1995-1997)

Results of Victorian asset sales

Asset	Type	AUD x 10 ⁹
United Energy	distributor/retailer	1.55
Solaris	distributor/retailer	0.95
Eastern Energy	distributor/retailer, rural	2.08
Powercorp	distributor/retailer, rural	2.15
Citipower	distributor/retailer	1.60
Yallourn W PS	1450 MW brown coal, 1974	2.43
Hazlewood PS	1600 MW brown coal, 1970	2.35
Loy Yang B PS	500 MW brown coal, 1993	1.00
Loy Yang A PS	2000 MW brown coal, 1986	4.85
Total power stations	5550 MW brown coal	11.6

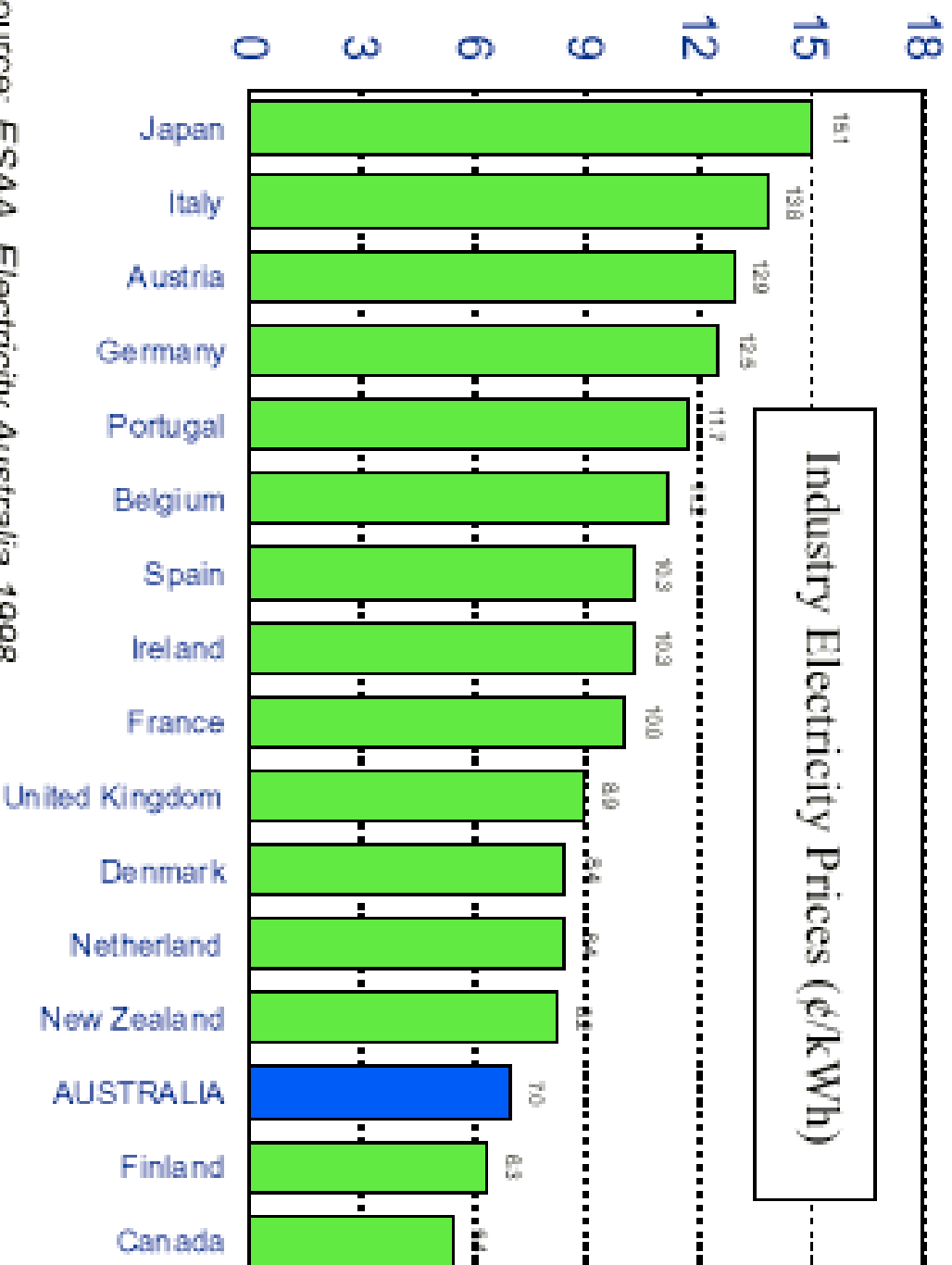
These brown coal power stations earned approximately AUD 1.1 x 10⁹ from energy sales in the year ending June 1995 (prior to subtracting operating costs)

Electricity Industry contribution to Australia's GDP (99/00 ~ \$10B pa Value Added or ~1% of GDP; 8.6M customers)



Source: ESAA, *Electricity Australia 1998*
© H. Outred 2002

International comparison of industrial electricity prices

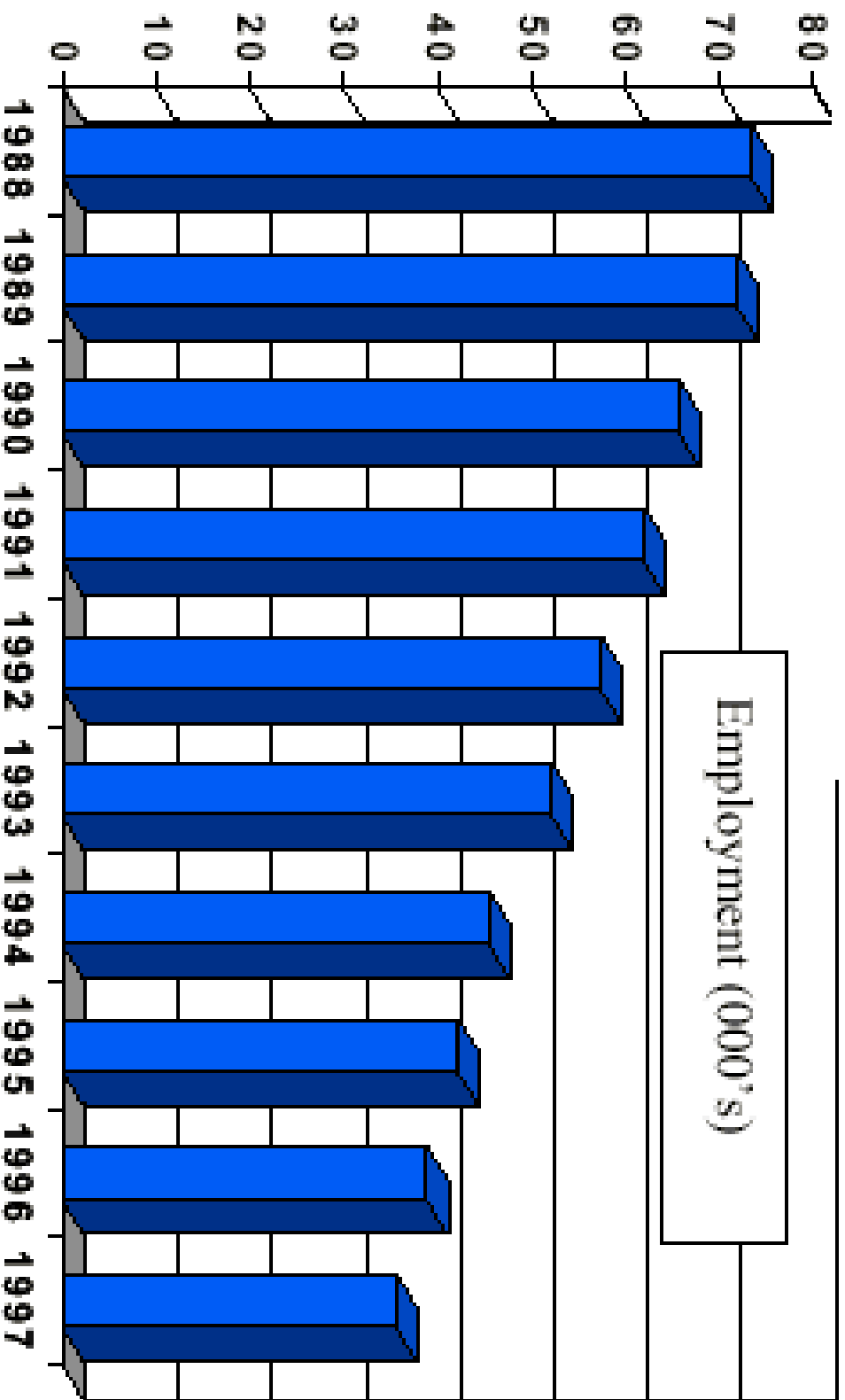


Source: ESMA, *Electricity Australia 1998*

© H. Outred 2002

Direct employment in the electricity industry

(Source: ESAA, 1988)

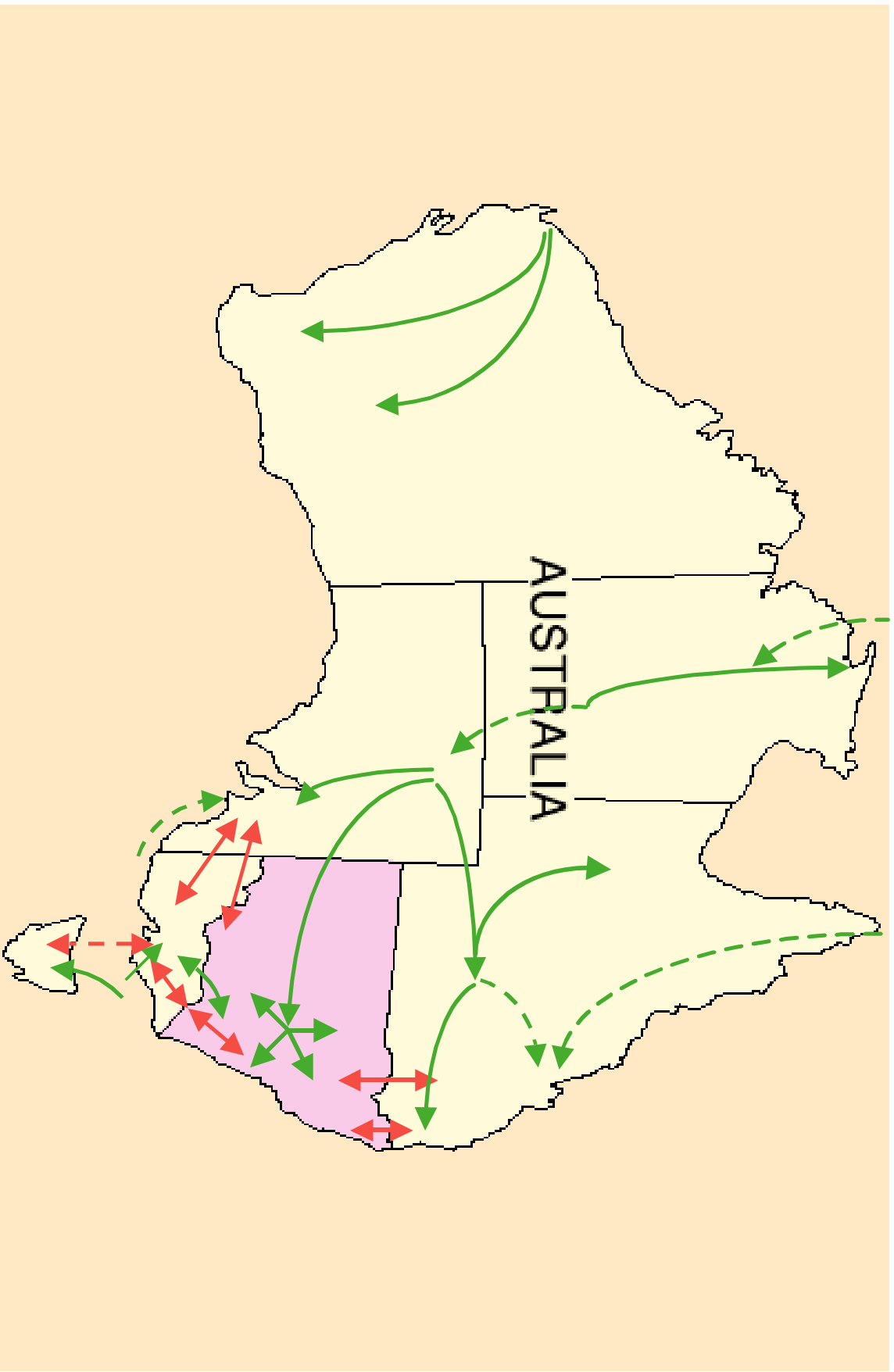


Key characteristics of the Australian electricity industry in 2001

(Source: ESAA, 1999, 2001, 2002)

- Structure:
 - ~20 large generating companies with in addition:
 - Independent power producers ~ 10% of capacity
 - 7 transmission & ~15 distribution companies
 - About 30 retailers & 8.6 million customers
- Electricity statistics:
 - Installed generating capacity ~ 42 GW
 - Annual sales (00/01) ~ 173,000 GWH
 - To ~8.6 million customers
 - Prices fell 36% in real terms, 1985 - 2000

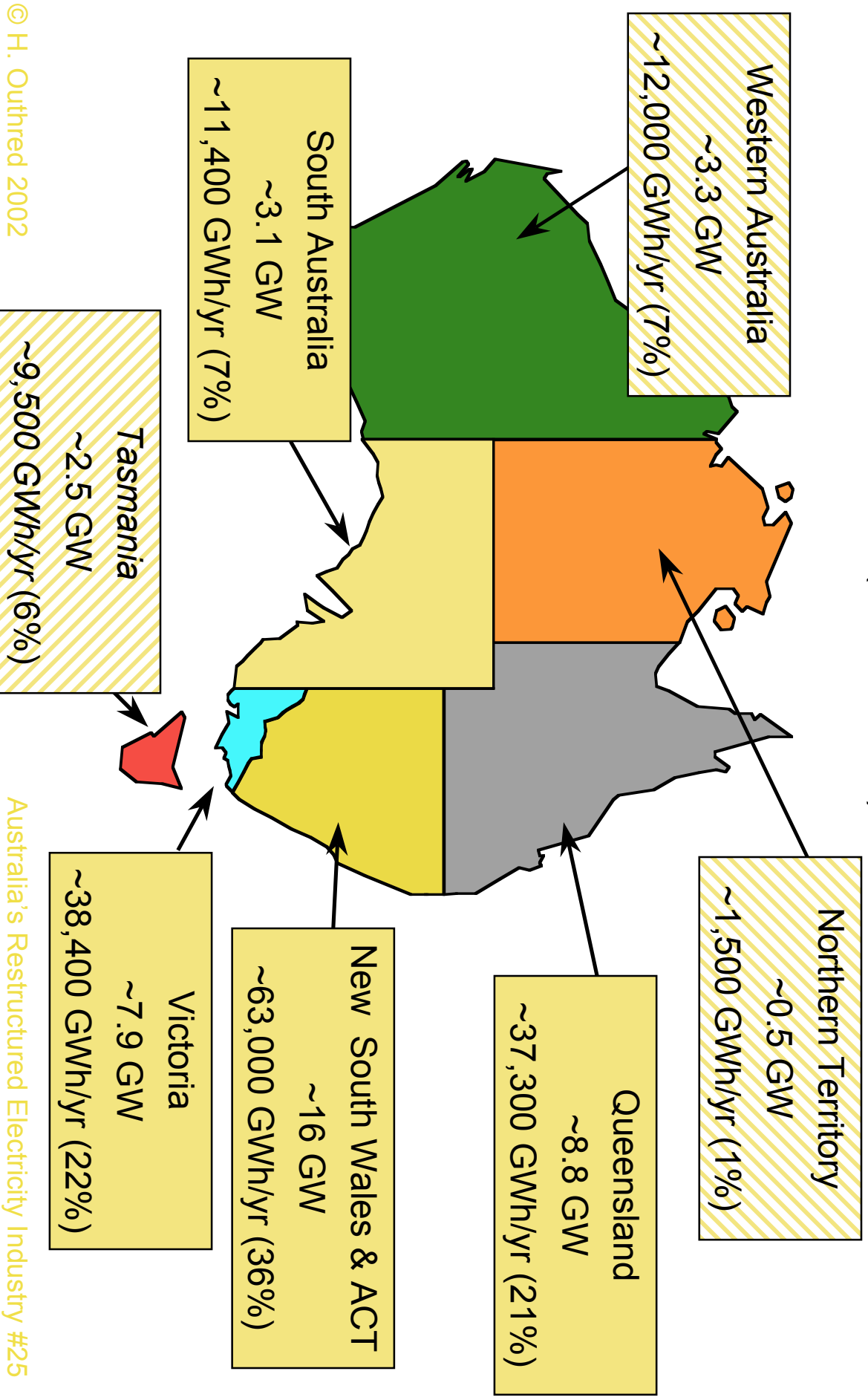
Interstate **electricity links** & major gas pipelines



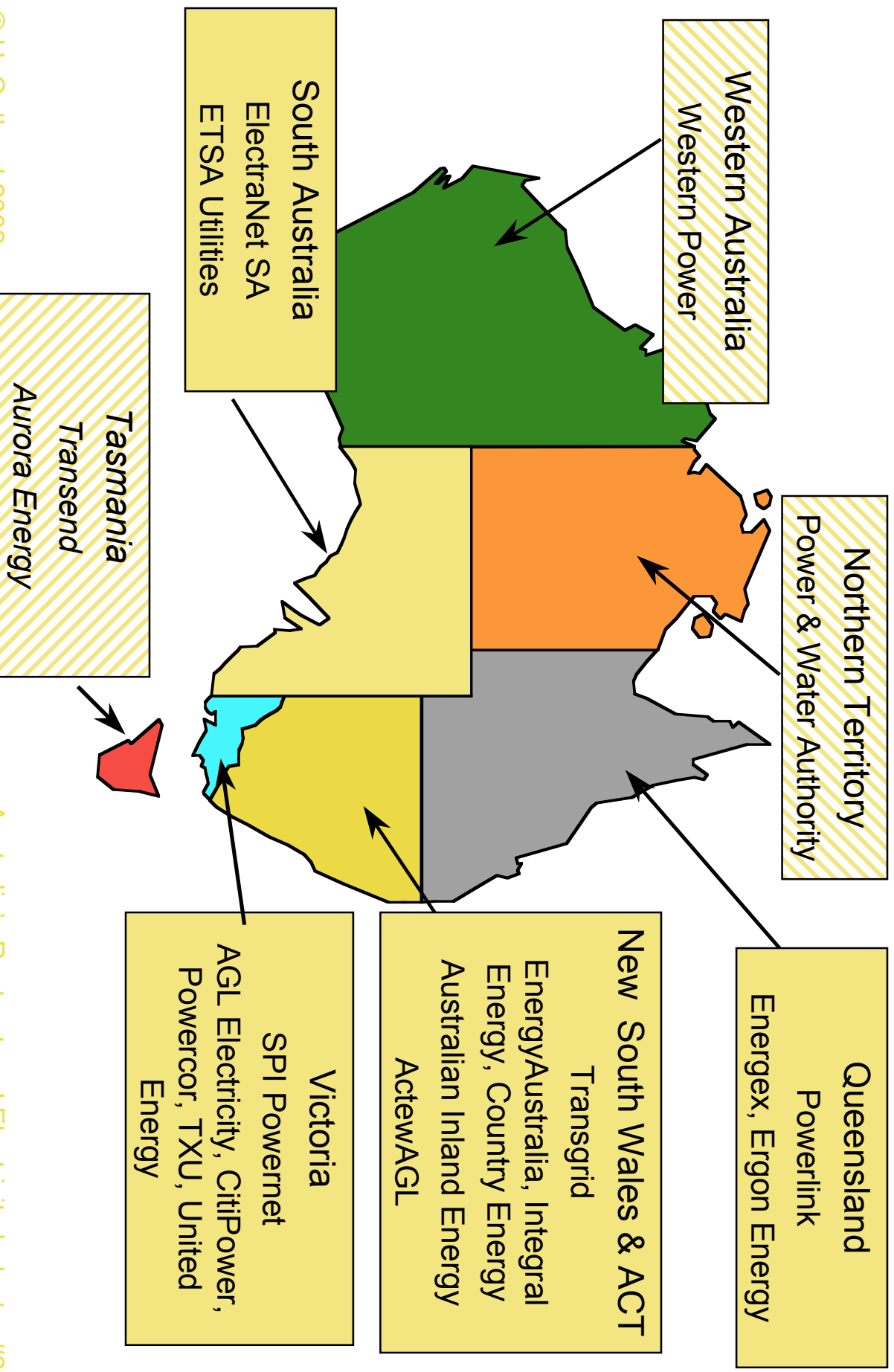
Capacity & energy sales (GWh/yr) for 00/01

With Tasmania, NEM would cover over 90% of all electricity sales

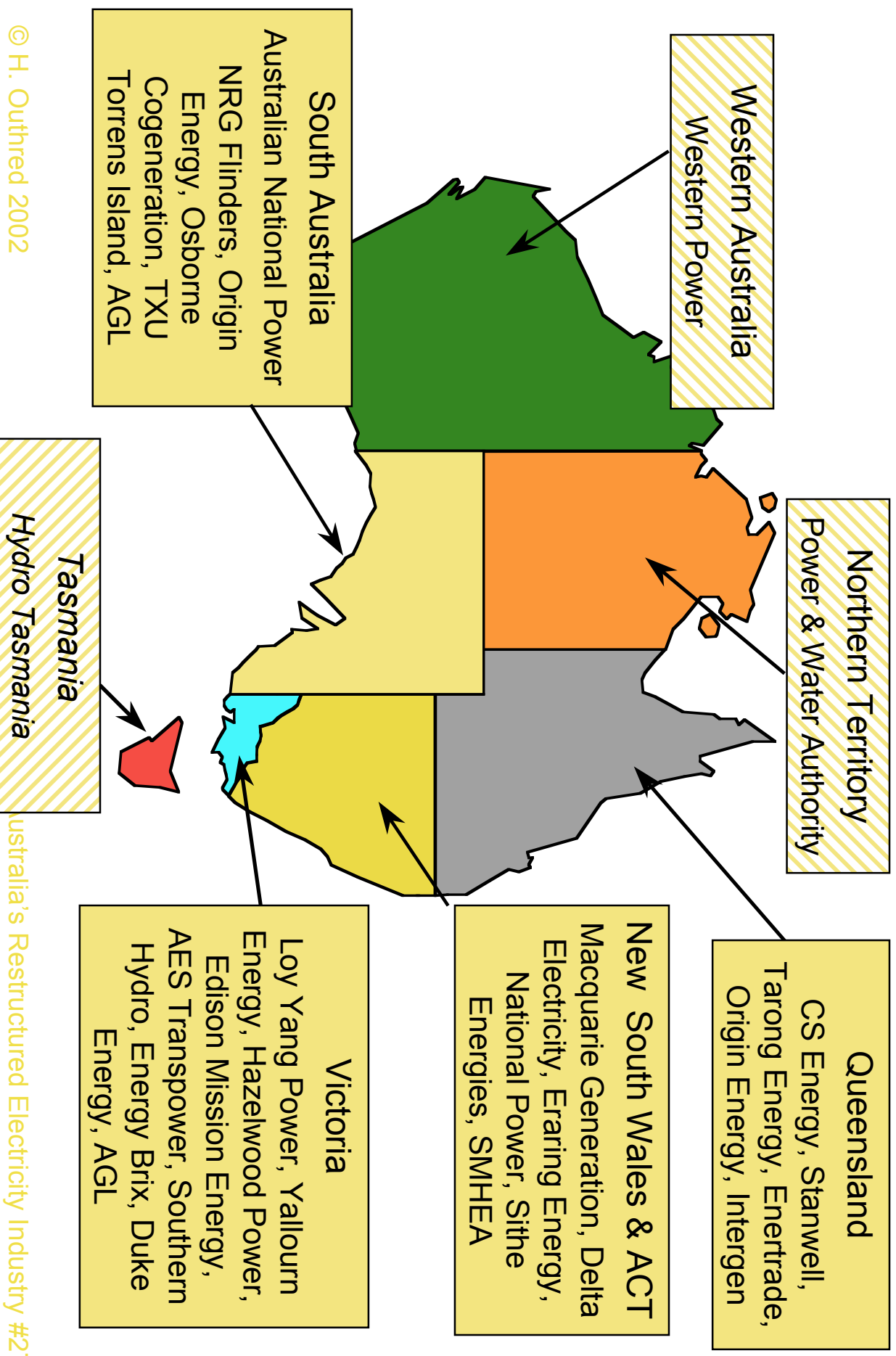
(ESAA, 2002)



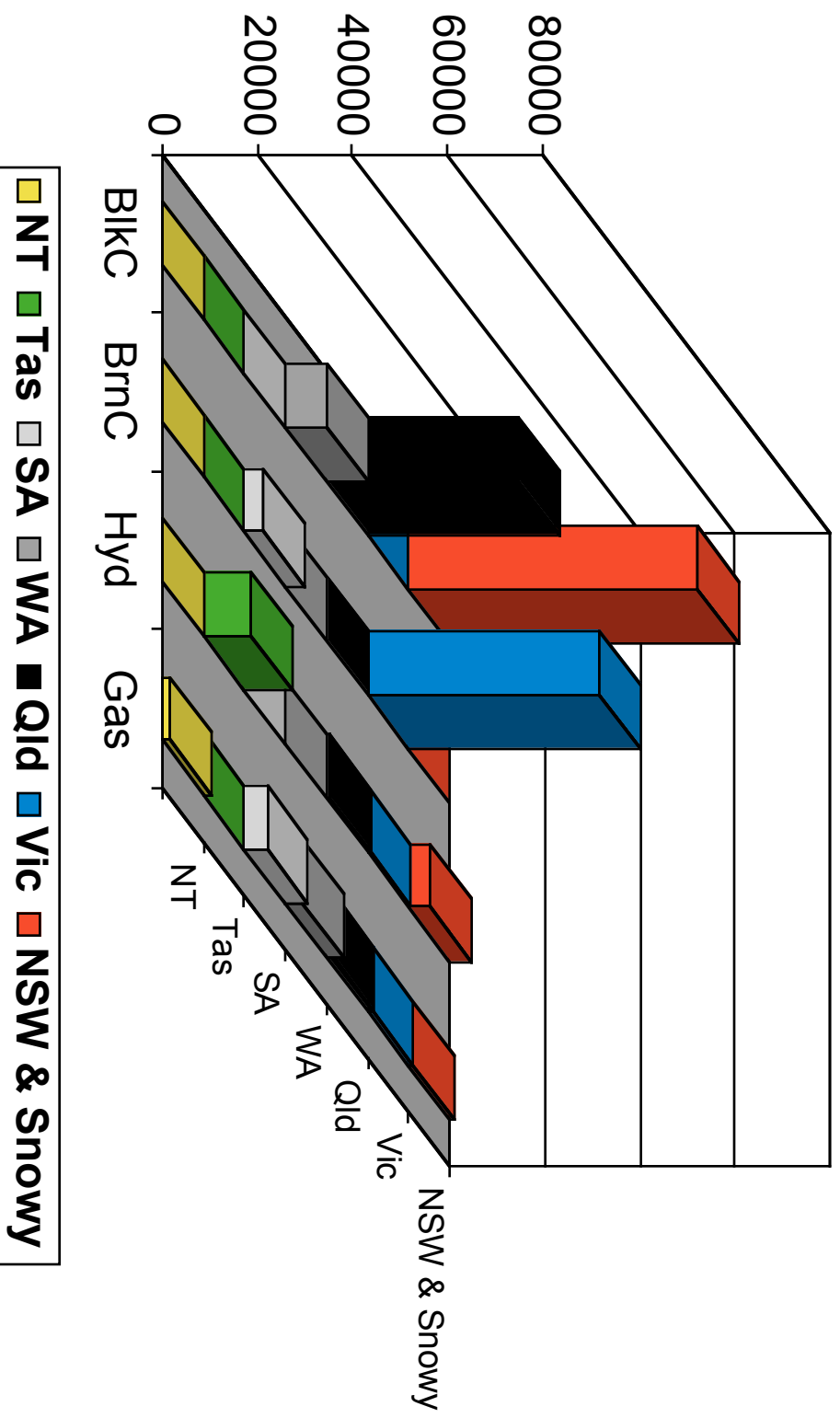
Network businesses



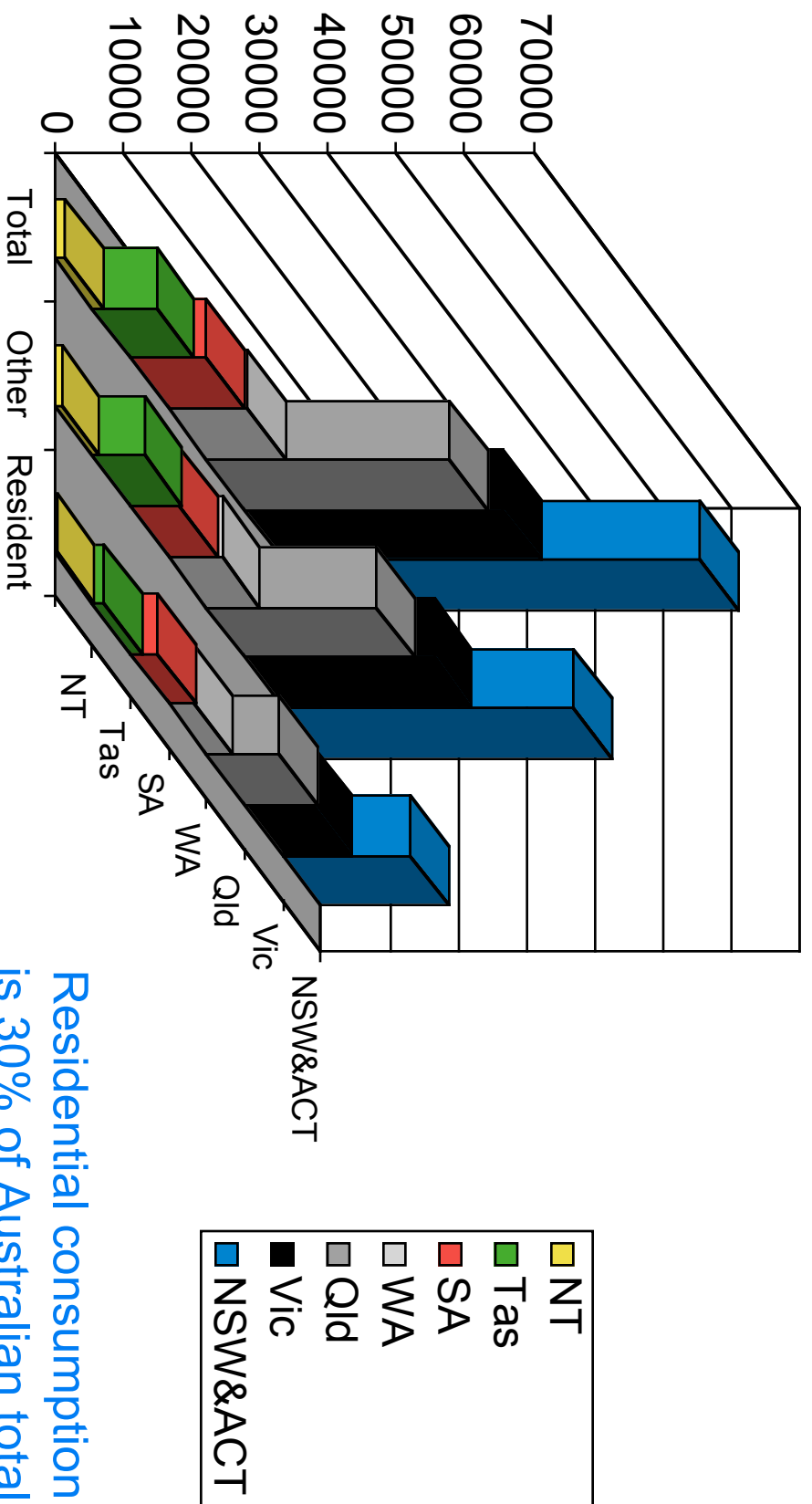
Generation businesses



Electricity generation by fuel type (GWH/yr) 1999/00 (ESAA, 2001)

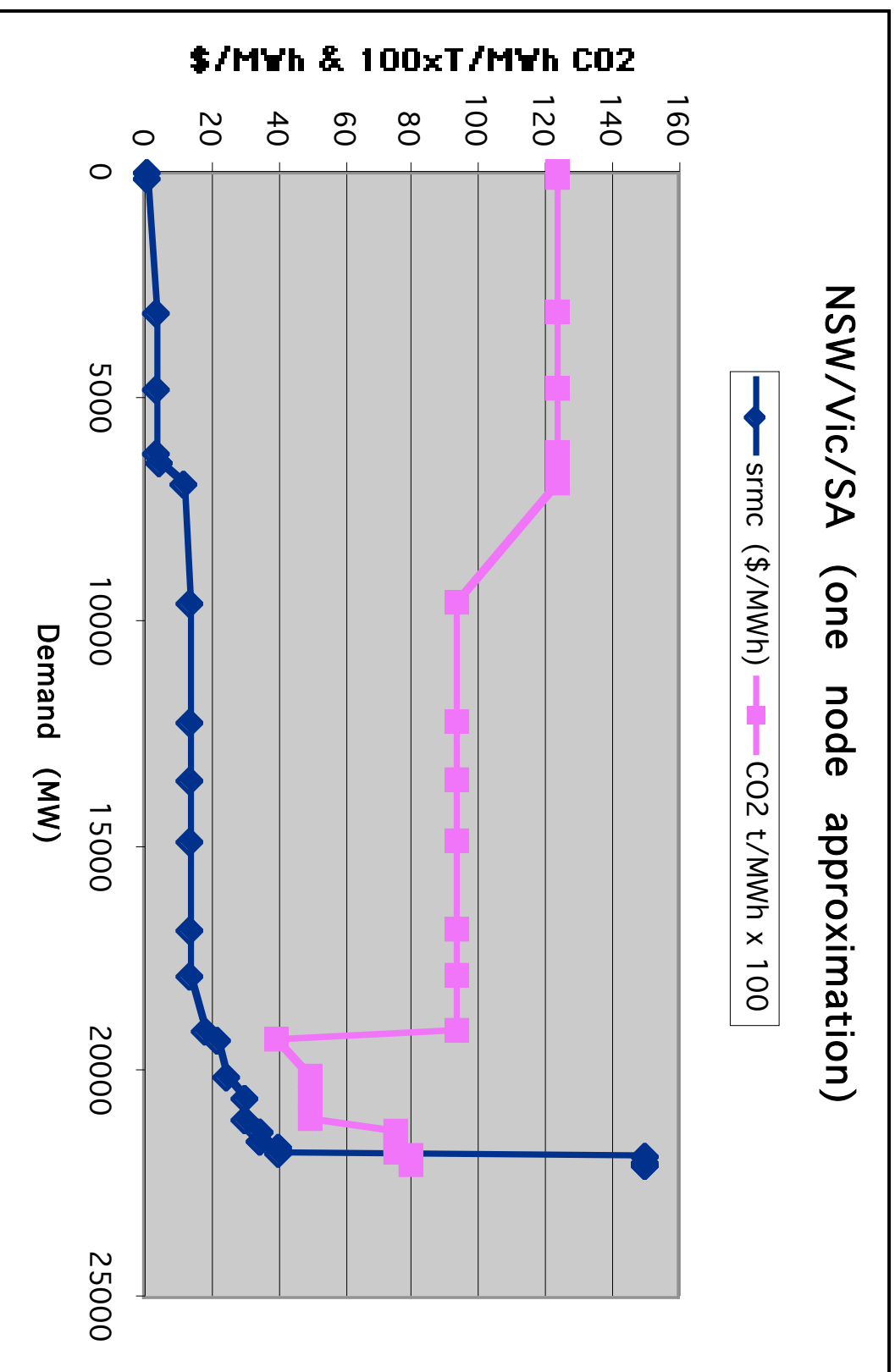


Electricity consumption by class (GWH/yr) 1999/00 (ESAA, 2001)



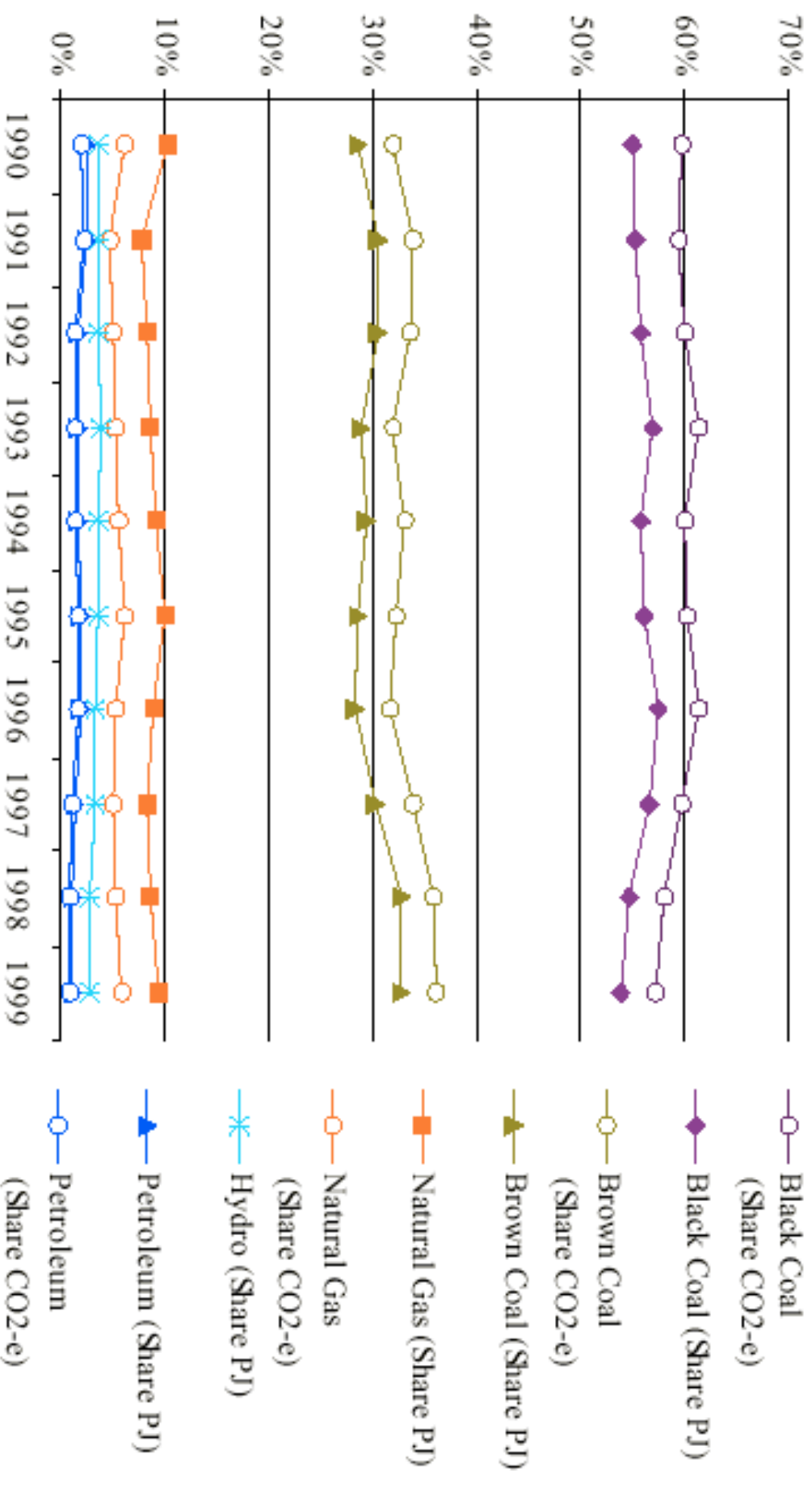
Residential consumption is 30% of Australian total (higher % in SA, lower in Tas)

NEM generators in order of operating cost (srmc) & generator CO2 coefficients

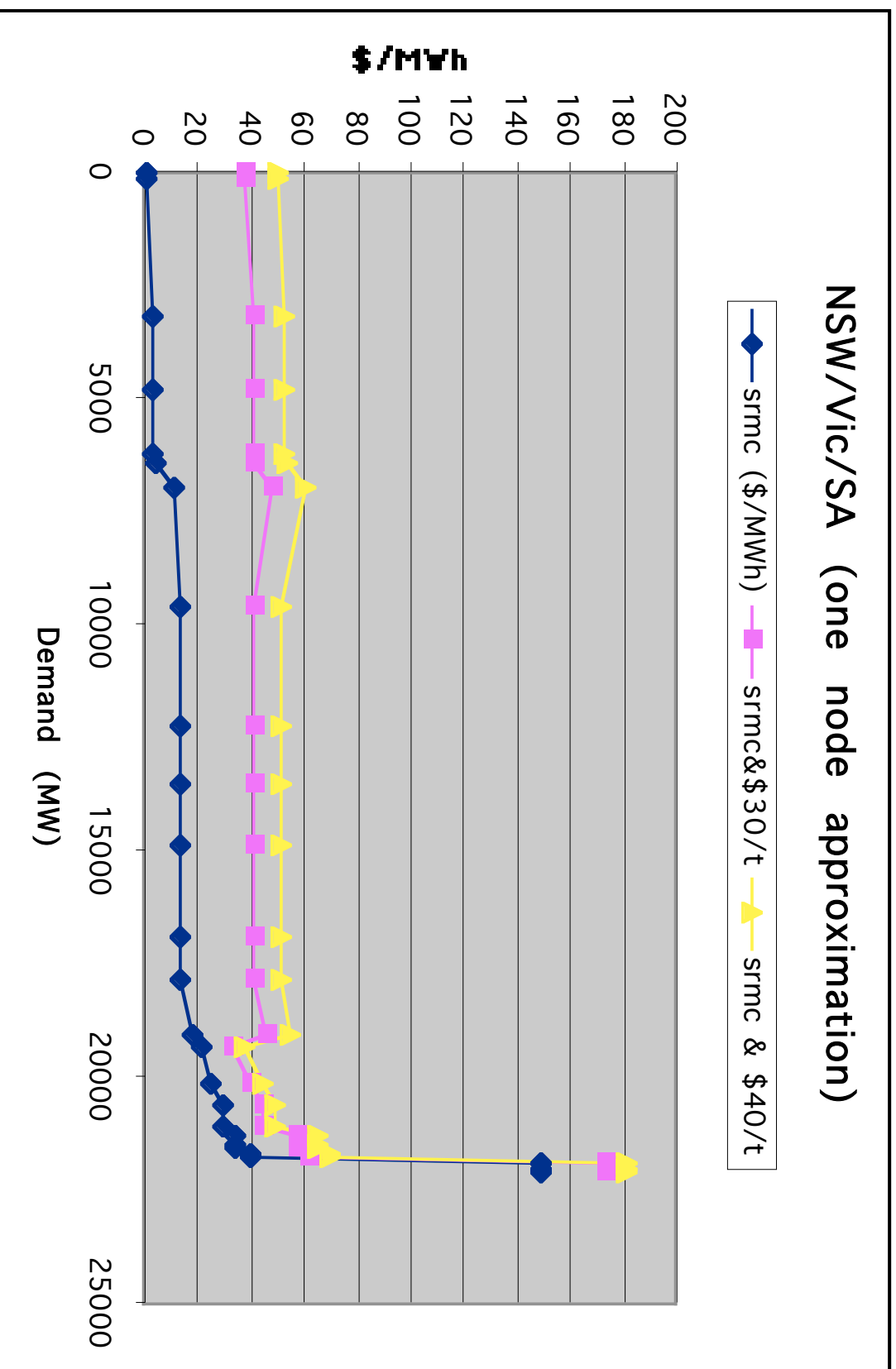


Shares of electricity generation & related emissions, 1990-99

(www.greenhouse.gov.au/inventory, 2001)



Effect of CO2 trading (or taxes) on NEM merit order

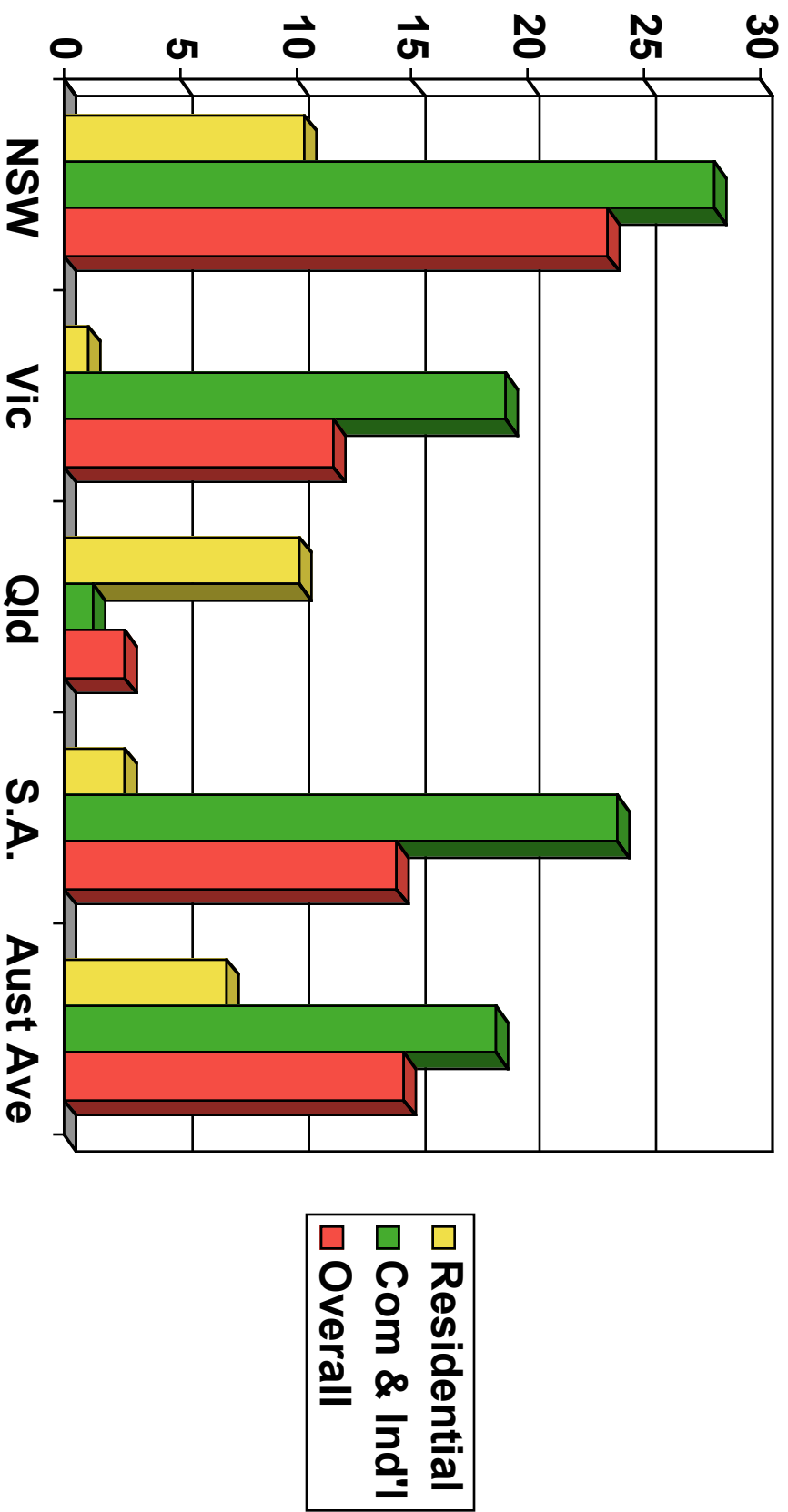


Introduction of retail competition

- States participating in NEM have introduced retail competition to varying degrees:
 - Contestable end-users choose a retail supplier
 - Initially applied only to largest end-users
 - Extended progressively to all end-users in NSW & Victoria
 - Australia has ~8 million residential & small commercial end-users in total

Retail price reductions 92/93-96/97

(% in real terms) (ESAA, 1999)



Comments on retail price trends

- Retail prices initially fell in all states
 - Business benefited more than residential
- NSW achieved the greatest price reductions:
 - Overall and in each category
 - While the ESI is still publicly owned
- Victorian residential consumers saw smaller price reductions than in other states:
 - Yet to see a price benefit from privatisation

Conclusions on restructuring

- Restructuring commenced in the early '90s
 - One decade to date & yet to be completed:
 - 7 Million residential consumers yet to become fully contestable (~ 30% of energy sold)
- Extent of disaggregation varies by state:
 - Some concerns about adequacy of competition
- Only Victoria has *fully* privatised utilities:
 - An intensely political issue
- 85% energy from coal-fired power stations:
 - High greenhouse impact (particularly brown coal)