Assessing options for static reactive compensation

TPAG Secretariat

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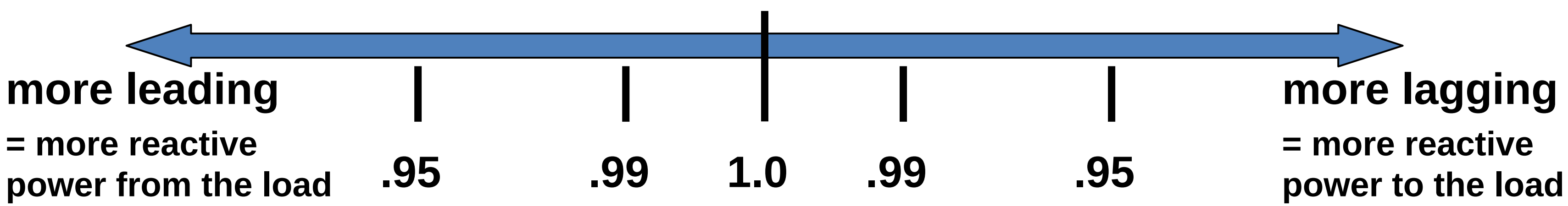
Overview

1. Background
2. Possible regulatory failures or efficiency gains
3. Alternative options
4. Assessment of options (efficiency considerations) relative to SQ
5. Conclusions

What is reactive power, why is it important & what is power factor?

- An ancillary ‘overhead’ component of the power transmitted, needed to keep the network ‘charged up’ (think: voltage)
- In regions where the supply of reactive power is relatively scarce, transmission constraints are hit earlier (‘voltage constraints’)
- Power factor is a measure of reactive power flow at a chosen point in the network
  - ‘unity’ = 1.0 p.f. = no reactive power flow at that point
  - lagging and leading power factor



Background

- Reactive power scarcity in voltage constrained regions – UNI & USI
  - changes to lower island regions not considered
- A range of options for
  - providing additional reactive power resources
  - reducing the reactive power demand
- ‘Unity power factor’ requirement
  - introduced by the Electricity Commission to assign cost responsibility for reactive power offtake
  - offtake customers and Transpower raised concerns over the unity power factor approach

Concerns

- Offtake transmission customers
  - unable to comply with the unity power factor requirement
- Transpower
  - unable to practically enforce the connection code power factor requirement
- TPAG conclusion – a regulatory failure exists
  - not possible to comply with a unity power factor obligation
  - enforcement via transmission agreements create practical difficulties and are convoluted
- Will lead to inefficient future investment in static reactive compensation equipment if not remedied

Alternative options considered

Options	Detail
Status Quo	
1: Amended status quo	Widen range of acceptable power factors to ‘unity *or leading*’
2: Connection charge	Include new regional SRC equipment as connection assets
3: kvar charge	Establish a kvar charge for reactive power drawn from grid during regional peak demand periods – ‘nominate and penalty’ methodology
4: Amended kvar charge	As for kvar charge but set charge at LRMC of SRC equipment and offset interconnection revenue. Retain a backstop minimum p.f. of 0.95

Amended kvar charge impact

	USI region	UNI region	Comment
LRMC of grid SRC equipment = kvar charge rate (per annum)	$4 – 5 /kvar	$4 – 5 /kvar	c.f. 2011/12 interconnection rate @ $76.14/kW
RCPD total reactive power demand	90 Mvar	285 Mvar	From 2010 RCPD data
kvar charge revenue (per annum)	$0.36 – 0.45M	$1.14 – 1.42M	
<u>Reduction</u> in interconnection rate (due to revenue substitution to the kvar charge)	$0.26 – 0.32 /kW (= 0.34 – 0.42 %)		From 2011/12 TPM: Interconnection rate = $76.14 /kW Total RCPD = 5,872 MW

Alternative options assessed

Options	Detail
Status Quo	
1: Amended status quo	Widen range of acceptable power factors to 'unity *or leading*'
4: Amended kvar charge	As for kvar charge but set charge at LRMC of SRC equipment and offset interconnection revenue. Retain a backstop minimum p.f. of 0.95

- Option 2 (connection charge) not considered further as it adds complexity, has the potential for hold out and is similar to kvar charge options
- Option 3 (kvar charge) not considered further as 'nominate & penalty' methodology not favoured due to forecasting uncertainty

Assessment of options 1 and 4

Efficiency considerations
1. Beneficiary pays
2. Locational price signalling
3. Unintended efficiency impacts
4. Competitive neutrality
5. Implementation, operating costs
6. Good regulatory practice

Efficiency consideration
1. Beneficiary pays

Assessment of options

Option 1 – amended status quo	**Option 4 – amended kvar charge**
Would implement beneficiary pays but only if offtake customers enter into new investment agreements with Transpower.	Implements beneficiary pays. Beneficiaries readily identifiable by their measured reactive power offtake. Does not require new investment agreements.
Conclusion: No advantage over SQ.	Conclusion: Superior to SQ.

Efficiency consideration
2. Locational price signalling

Assessment of options

Option 1 – amended status quo	Option 4 – amended kvar charge
Would provide locational price signalling but only if offtake customers enter into new investment agreements with Transpower.	Provides locational price signalling. Quantifiable benefits for distribution networks: •up to $10M network loss reduction •up to $25M thermal capacity increases
Conclusion: No advantage over SQ.	Conclusion: Superior to SQ. Up to $35M of distribution network benefits may be realised.

Efficiency consideration
3. Unintended efficiency impacts

Assessment of options

Option 1 – amended status quo	Option 4 – amended kvar charge
Same as SQ.	Shifts some revenue between kvar charge and interconnection charge, hence between different transmission customers. But, very small impact only.
Conclusion: No advantage over SQ.	Conclusion: Inferior to SQ but not significantly so.

Efficiency consideration
4. Competitive neutrality

Assessment of options

Option 1 – amended status quo	Option 4 – amended kvar charge
No competition issues raised.	No competition issues raised.
Conclusion: No advantage over SQ.	Conclusion: No advantage over SQ.

Assessment of options

Efficiency consideration
5. Implementation & operating costs

Option 1 – amended status quo	Option 4 – amended kvar charge
Same as SQ. Small regulatory cost to amend Code.	Offtake customers may incur higher capex costs for same kvar capacity installed. •up to $8M assessed One-off implementation costs for billing system upgrade •up to $0.6M
Conclusion: Very small cost compared with SQ.	Conclusion: Higher costs of up to $8.6M against SQ.

Efficiency consideration
6. Good regulatory practice

Assessment of options

Principle	Option 1	Option 4 – amended kvar charge
Consistency between regulators	all same as SQ	Compatible with ComCom transmission alternatives
Durability		Favoured in previous consultations by offtake customers
Consistency over time		Change from SQ => not consistent with past
Consistency over whole grid		Not consistent across whole grid (upper vs lower regions)
Wealth transfers & step changes in price		Initial transfer and step for some but relatively small impact
Market fit		Similar methodology to current interconnection charge

Summary

Efficiency consideration	Option 1: Amended status quo	Option 4: Amended kvar charge
2. Location Pricing	$0	$10.5m to $35m
5. Implementation & on-going costs Billing system upgrade Additional DTC capex	 $0 $0	 -$0.4m to $0.6m -$4m to $8m
Quantified benefit (NPV 30yr)	**$0**	**$6.1m - $26.4m**
1. Beneficiary pays	same	✓
3. Unintended price impacts	same	same
4. Competitive neutrality	same	same
6. Good Regulatory practice 1. Consistency btw regulators 2. Durability 3. Consistency over time 4. Consistency over grid 5. Wealth transfers 6. Price step changes 7. Market fit	all same	 ✓ ✓ X X X (very small) X (very small) ✓
Qualitative Score	**X**	**✓**

Conclusions

- Introduction of an efficient charge for reactive power offtake during regional peak periods for the UNI & USI regions supported
  - Indicative charge ~$5/kvar
- A minimum power factor of 0.95 lagging as a practical back stop
  - penalty charge for demand in excess of this lower limit
- A reactive power charge for the lower island regions?
  - consistent approach across the whole grid desirable
  - views of submitters are sought on this