UTS: INSTITUTE FOR SUSTAINABLE FUTURES

RESEARCH STRENGTH

ISF PRELIMINARY RESEARCH RESULTS: LOCAL NETWORK CHARGES & VIRTUAL NET METERING

AEMC LGNC CONSULTATION WORKSHOP
ED LANGHAM, LAWRENCE MCINTOSH
SYDNEY, 15 MARCH 2016

NOTE: INCLUDES MINOR AMENDMENTS FROM WORKSHOP VERSION

PRESENTATION OVERVIEW

- **The ISF/ARENA project**
- **Network charges – what happens now**
- **LNC calculation methodology**
  - Development process
  - Principles
  - Components
  - Precedents
  - Value calculation
  - Tariff calculation
- **Preliminary trial results:**
  - LNC values
  - Financial impacts for customers and NSPs
- **Preliminary Conclusions**

THE PROJECT: FACILITATING LOCAL NETWORK CHARGES* AND LOCAL ELECTRICITY TRADING**

** ~LOCAL GENERATION NETWORK CREDIT*

*** aka VIRTUAL NET METERING (VNM)*

THE PROJECT IS THE FIRST QUANTITATIVE TESTING OF AN LGNC IN THE AUSTRALIAN MARKET

THE PROBLEM WE'RE TRYING TO ADDRESS

- Full network charges are paid by customers irrespective of where the electricity was sourced (across the street or 250km away)
  - DG sell at wholesale and buy back at retail prices (incl. full network and retail/energy charges)
  - Lower use of system costs not recognised for locally consumed DG
  - **In context of Rule Change: "The value of (esp. smaller) DG exports to the local network is not currently recognised"**
- Strong incentive for customers (and product developers) to focus on "behind the meter" solutions & reduce grid consumption
- Perverse incentive to duplicate infrastructure (private wires)
- Sub-optimal generator sizing & operation in terms of avoiding future network costs
- Status quo will increase costs for consumers left using *only* grid electricity, as infrastructure costs are recouped from smaller sales volumes

Within scope of Rule Change consideration

WHAT WE'RE DOING

Objective: **to facilitate local network charges & local electricity trading**

- Five case studies, or "virtual trials", of LNC and LET
- A recommended methodology for calculating LNCs
- An assessment of the technical requirements and indicative costs for the introduction of LET
- Economic modelling of the benefits & impacts of LNCs and LET
- Increased industry understanding of LNCs and LET
- Specific consultation and support for rule change proposal(s)

WHO'S INVOLVED

PROJECT LEAD

UTS:ISF
INSTITUTE FOR SUSTAINABLE FUTURES

MAIN SPONSOR

ARENA
Australian Government
Australian Renewable Energy Agency

SWAN HILL
Rural City Council

Byron Shire Council

WILLOUGHBY CITY COUNCIL

ERGON ENERGY

CITIPOWER

Powercor AUSTRALIA

Energy in action.
Since 1837
AGL

MOIRA SHIRE
ON THE MURRAY

CITY OF SYDNEY

Total Environment Centre
for the future

wannonWATER

NSW GOVERNMENT
Renewable Energy Advocate

Networks NSW

Energy Australia

Origin Energy

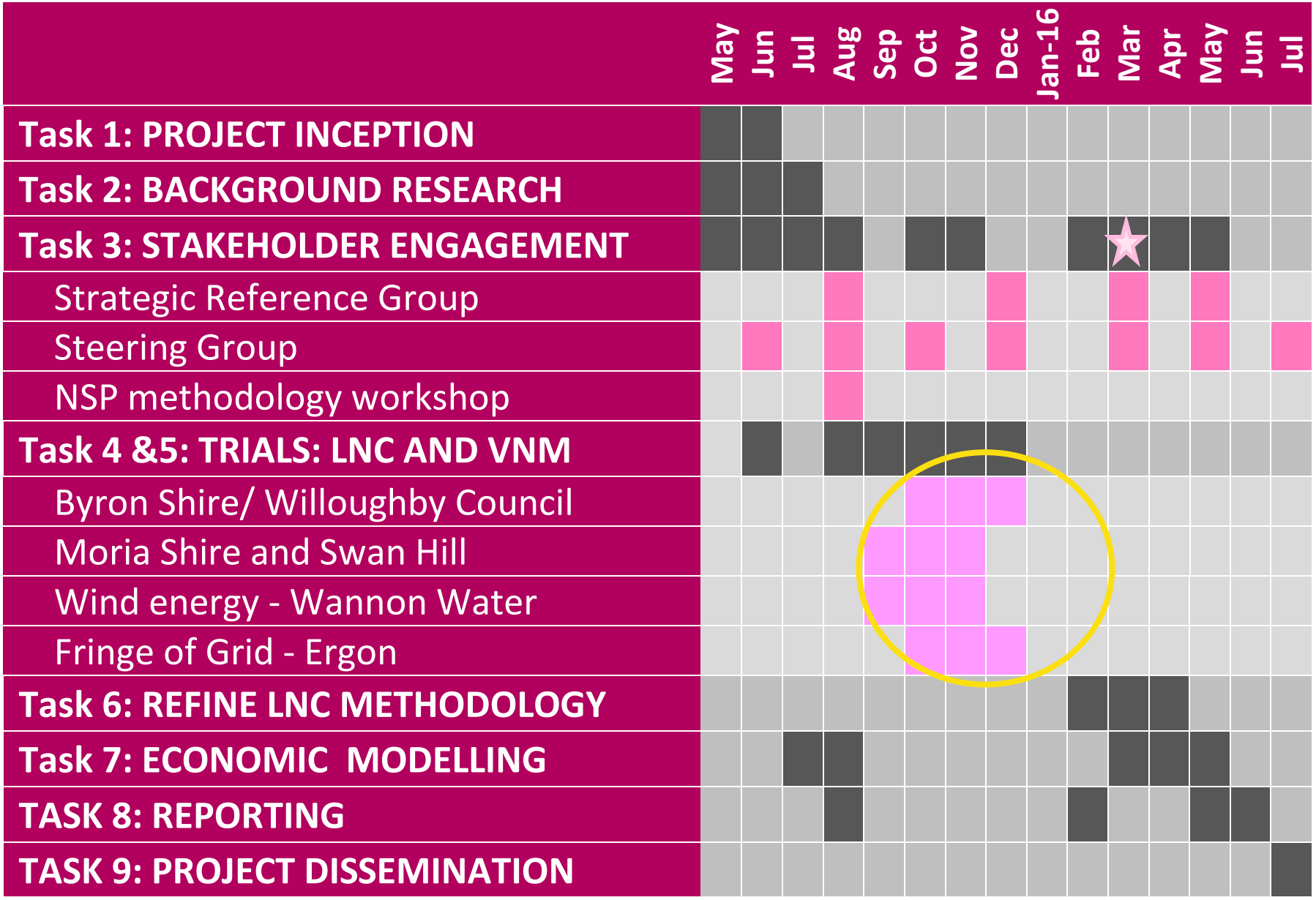
Australian Energy Council

Electricity Networks Association

Clean Energy Council

Coalition for Community Energy

TIMEFRAME


May
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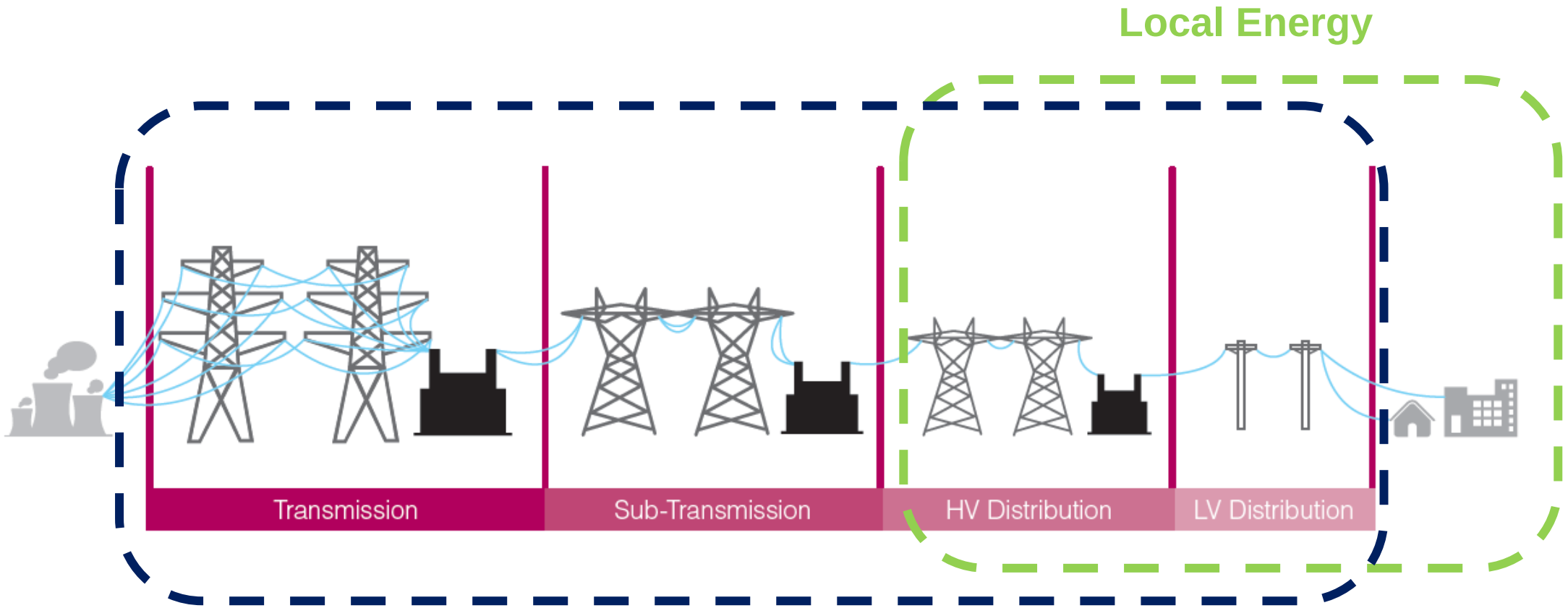
Task 1: PROJECT INCEPTION
Task 2: BACKGROUND RESEARCH
Task 3: STAKEHOLDER ENGAGEMENT
Strategic Reference Group
Steering Group
NSP methodology workshop
Task 4 &5: TRIALS: LNC AND VNM
Byron Shire/ Willoughby Council
Moria Shire and Swan Hill
Wind energy - Wannon Water
Fringe of Grid - Ergon
Task 6: REFINE LNC METHODOLOGY
Task 7: ECONOMIC MODELLING
TASK 8: REPORTING
TASK 9: PROJECT DISSEMINATION

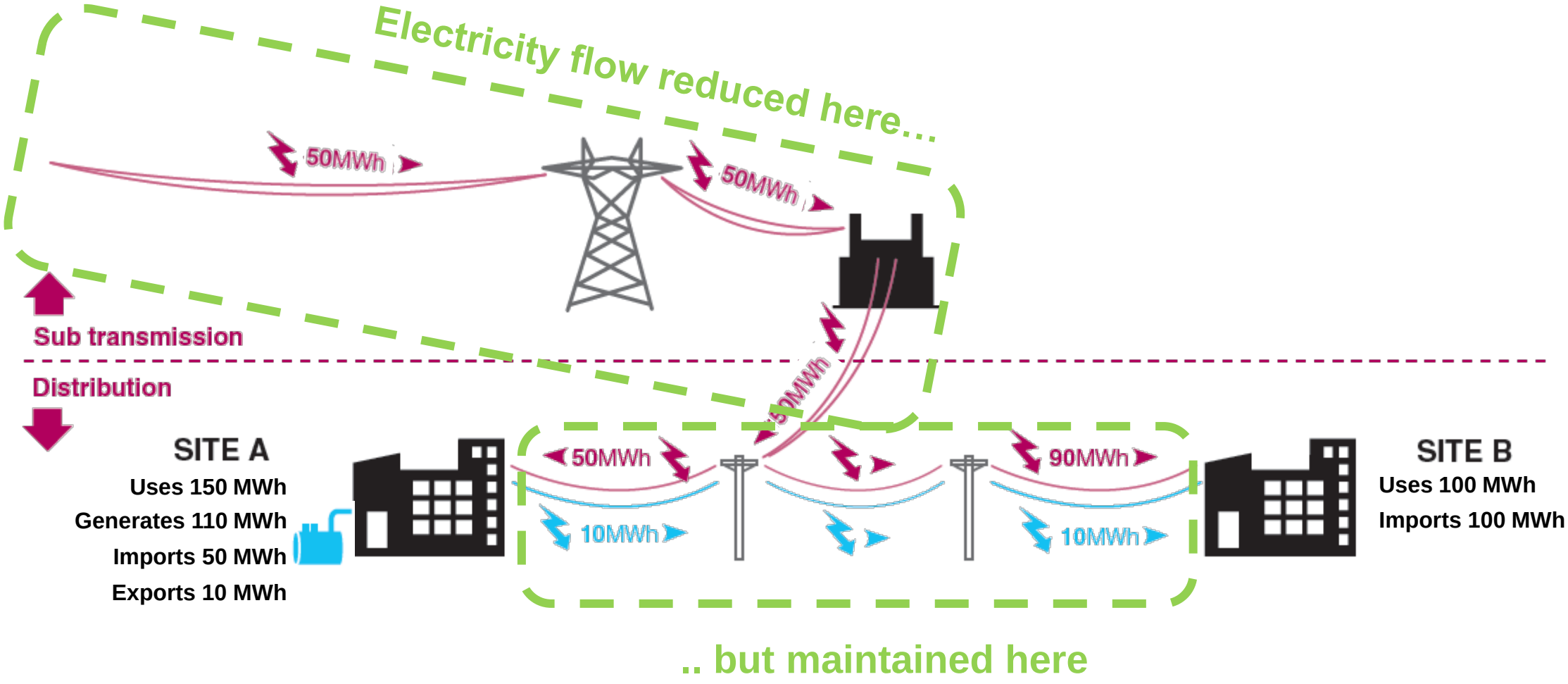
NETWORK CHARGES – WHAT HAPPENS NOW

NETWORK CHARGES - WHAT HAPPENS NOW



Current network charges for local energy

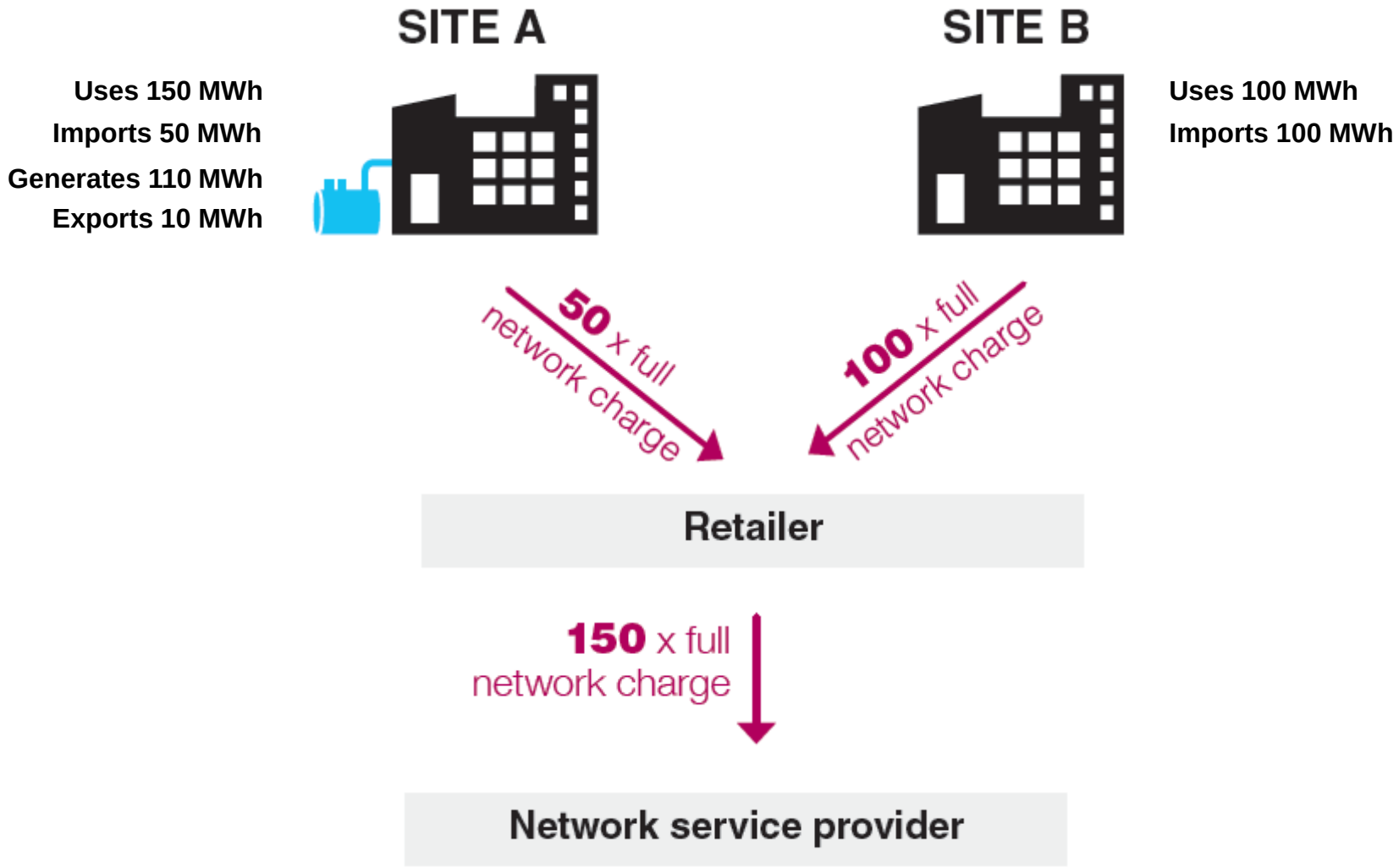
PHYSICAL ELECTRICITY FLOWS



MONETARY FLOWS WITH AND WITHOUT LGNC

MONETARY FLOWS

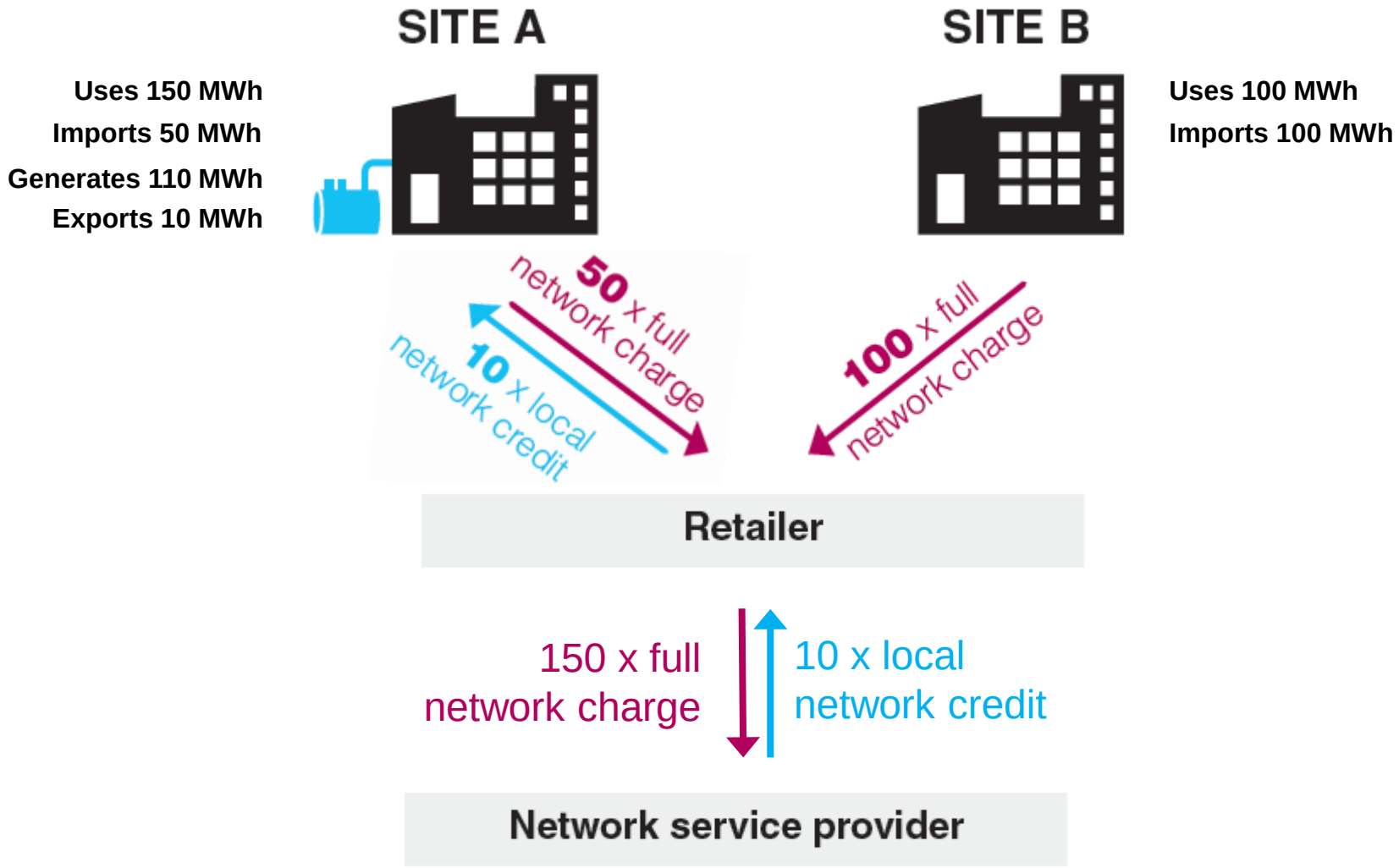
CURRENT NETWORK CHARGES



MONETARY FLOWS

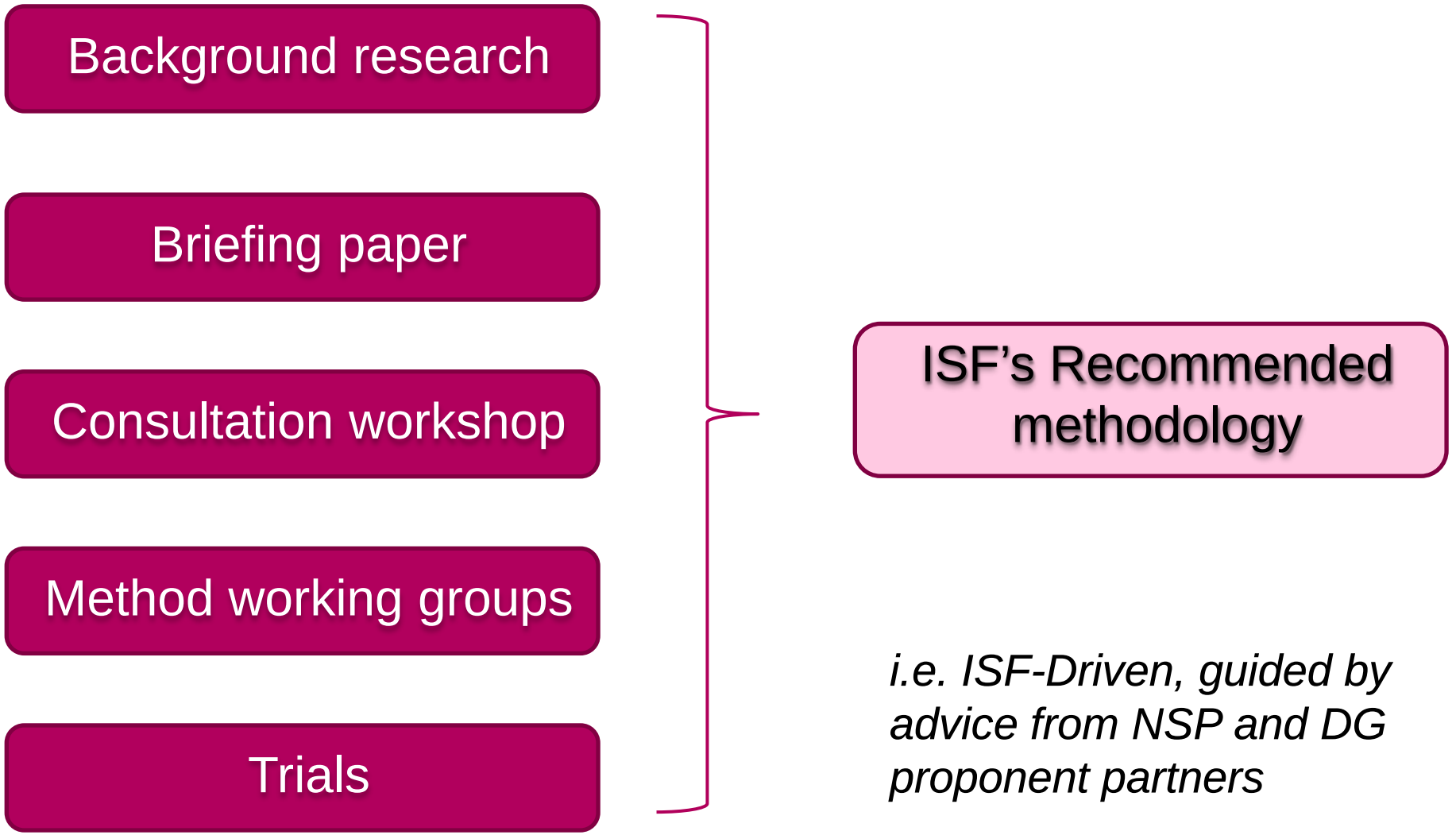
LOCAL NETWORK CHARGES

Local Generator Network Credit

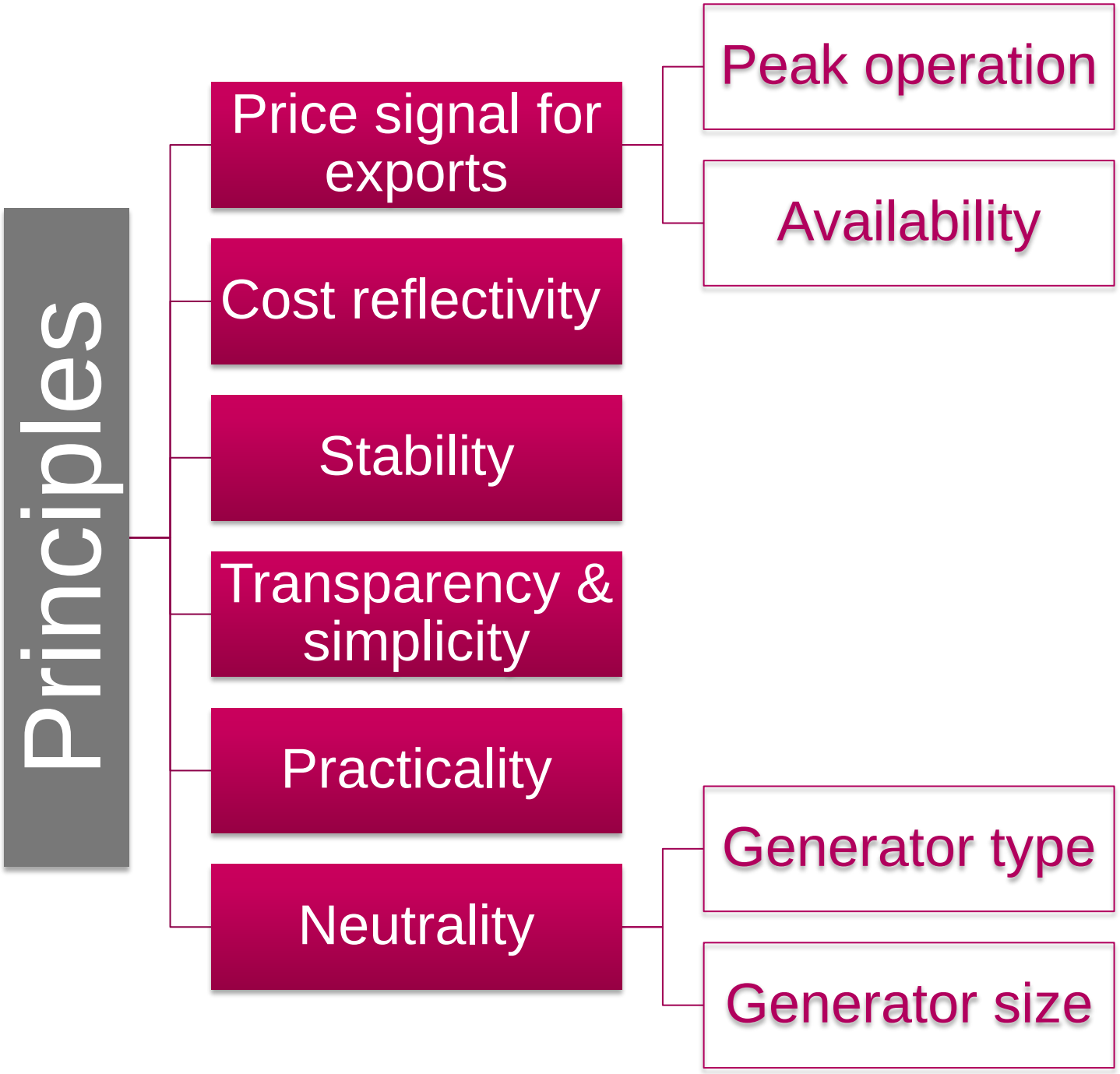


LNC CALCULATION METHODOLOGY

HOW WE'VE DEVELOPED IT



i.e. ISF-Driven, guided by advice from NSP and DG proponent partners


Principles
Price signal for exports
Peak operation
Availability
Cost reflectivity
Stability
Transparency & simplicity
Practicality
Neutrality
Generator type
Generator size

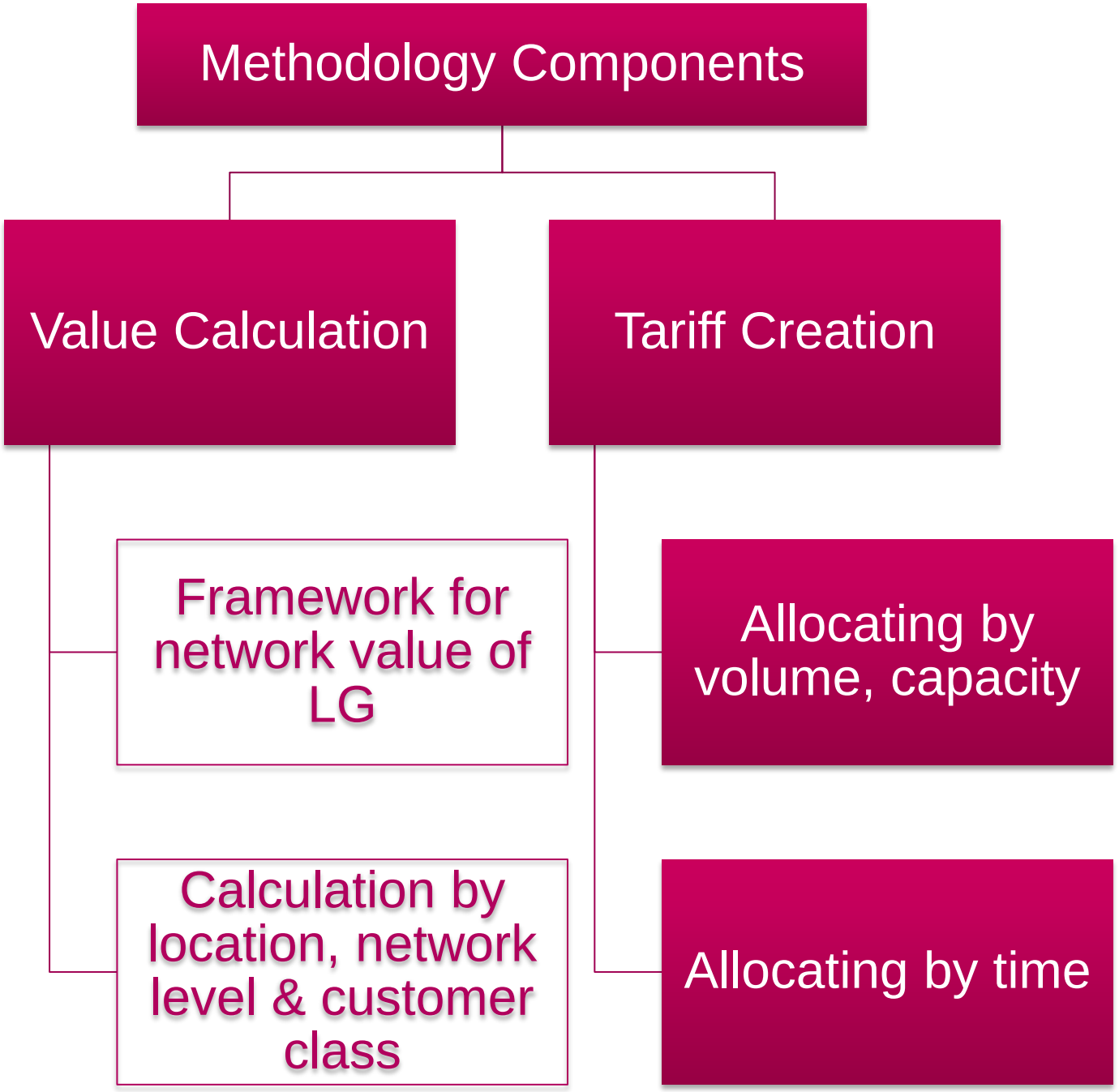
PRECEDENTS

METHODOLOGIES INVESTIGATED

Methodology	Value calculation	Location	Time	Payment structure [Additional values]	Operation	Availability	Cost Reflectivity	Stability	Transparency	Implementation	Neutrality
UK CDCM	Marginal Cost based on 500MW increments	By voltage level	Probabilistic: based on peak periods and estimated generation	Volumetric [Losses]	✓	✗	✓ ✗	✓	✓ ✗	✓	✓ ✗
Connecticut	Declining percentage of DUOS and TUOS	Generator and consumer in same distribution territory	Applies to exports not consumed by customers other sites within billing period	Volumetric	✗	✗	✗	✓	✓	✓	✗
Minnesota	NPV of value of generator over its lifetime. Load and generation data for 12 months (hourly basis)	Assumed low voltage (LV) (Solar only)	All	Volumetric, [avoided generation, capacity, ancillary services and environmental benefits]	✗	✗	✓	✓	✓ ✗	✗	✗
ActewAGL	Estimate avoided TUOS	Assume LV (Solar only)	All	Volumetric	✗	✗	✗	✓	✗	✓	✗
Ausnet	Unknown	Assume LV (Solar only)	Summer generation only	Volumetric	✓ ✗	✗	?	✓	✗	✓	✗
Reference service approach[1]	Lowest avoided cost	Very location specific, requires user to be identified			✗	✗	✓	✓	✗	✗	✓ ✗

1 Both Western Australia in the WA Wheeling Method and Transmission pricing guidelines include a methodology based on this approach

METHODOLOGY COMPONENTS


Methodology Components
Value Calculation
Tariff Creation
Framework for network value of LG
Calculation by location, network level & customer class
Allocating by volume, capacity
Allocating by time

VALUE CALCULATION: LRMC

FRAMEWORK FOR NETWORK VALUE OF LOCAL GEN

- **Reference Service Approach:** Cost a private wire to connect generator with demand, which can be used for network to offer 'prudent discount' on cost of services.

✗ Fails practicality principle

- **LRMC of Network Services Approach:** Quantify avoided costs, including:
  - Growth-related augmentation (capex)
  - Replacement costs (capex)
  - Associated operating costs (opex)
  - (All *long term* costs: 15-20+ years)

✓ Cost reflectivity principle

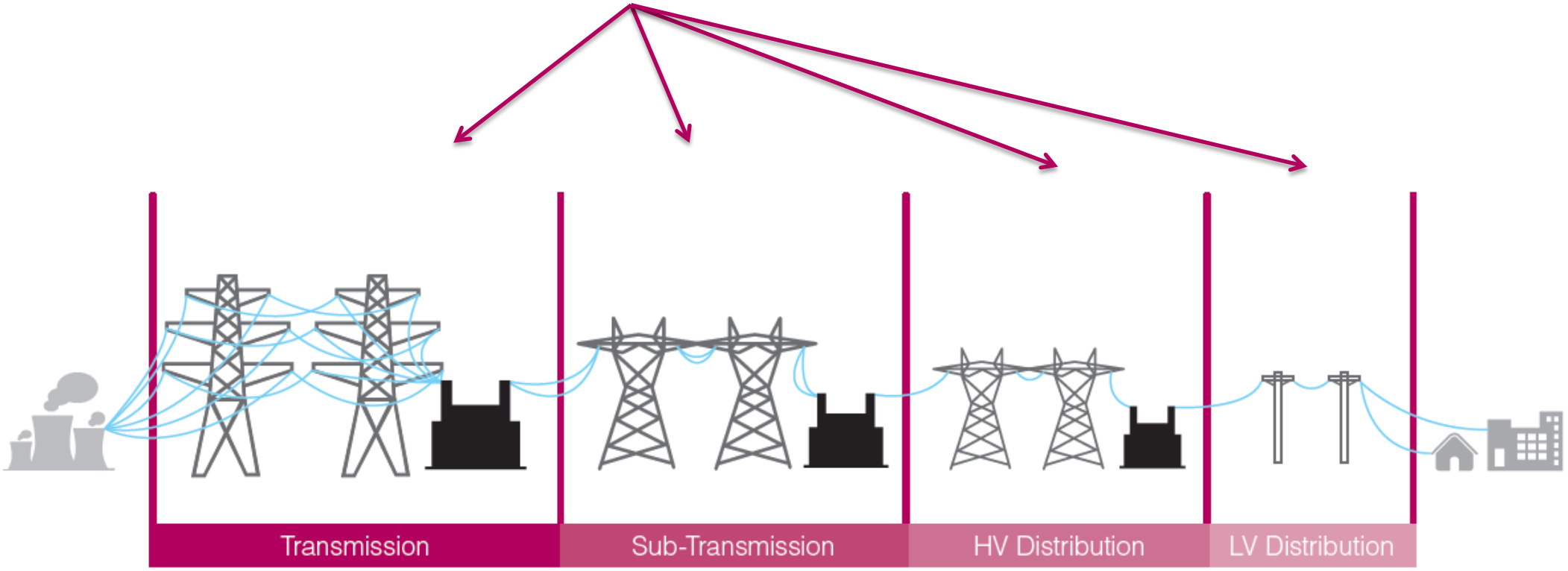
LRMC CALCULATION METHOD

- NSPs to apply same method they already apply for consumption tariffs
  - **Pros**: easy for NSPs to implement; potentially equitable; reflects cost-reflective network pricing reform process
  - **Cons**: if current LRMC calculation ignores replacement or opex, or takes short term (5-10yr) horizon, credit value may be too low

LRMC CALCULATION BY LOCATION, LEVEL, CLASS

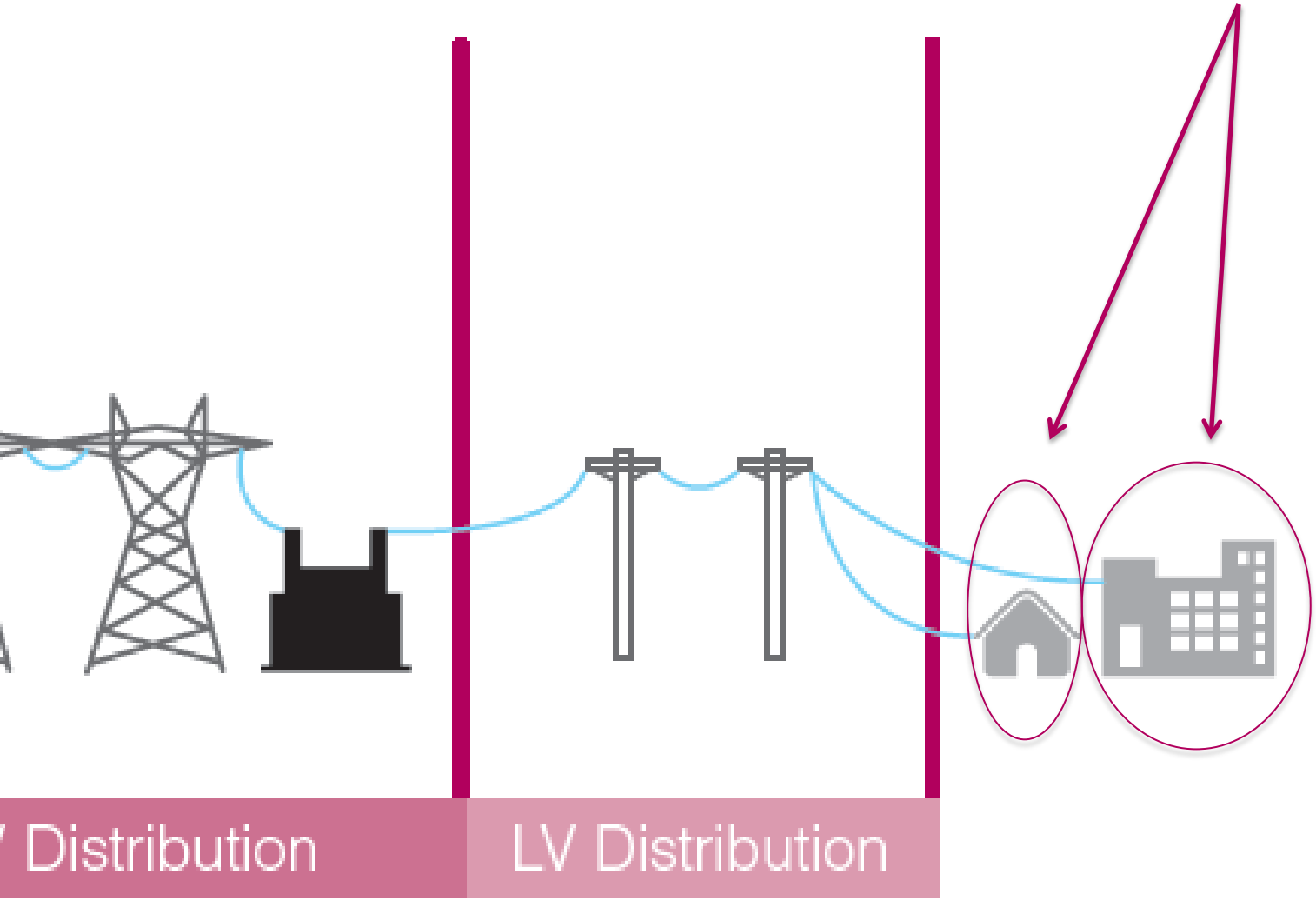
- Locational only to the extent that Network Businesses use different pricing zones for consumption tariffs

LRMC CALCULATION BY LOCATION, LEVEL, CLASS



Level of Generator Connection

LRMC CALCULATION BY LOCATION, LEVEL, CLASS



Customer Class

LRMC CALCULATION: THE END RESULT

Table 3: Sample table for LRMC by network level & customer class (dummy data)

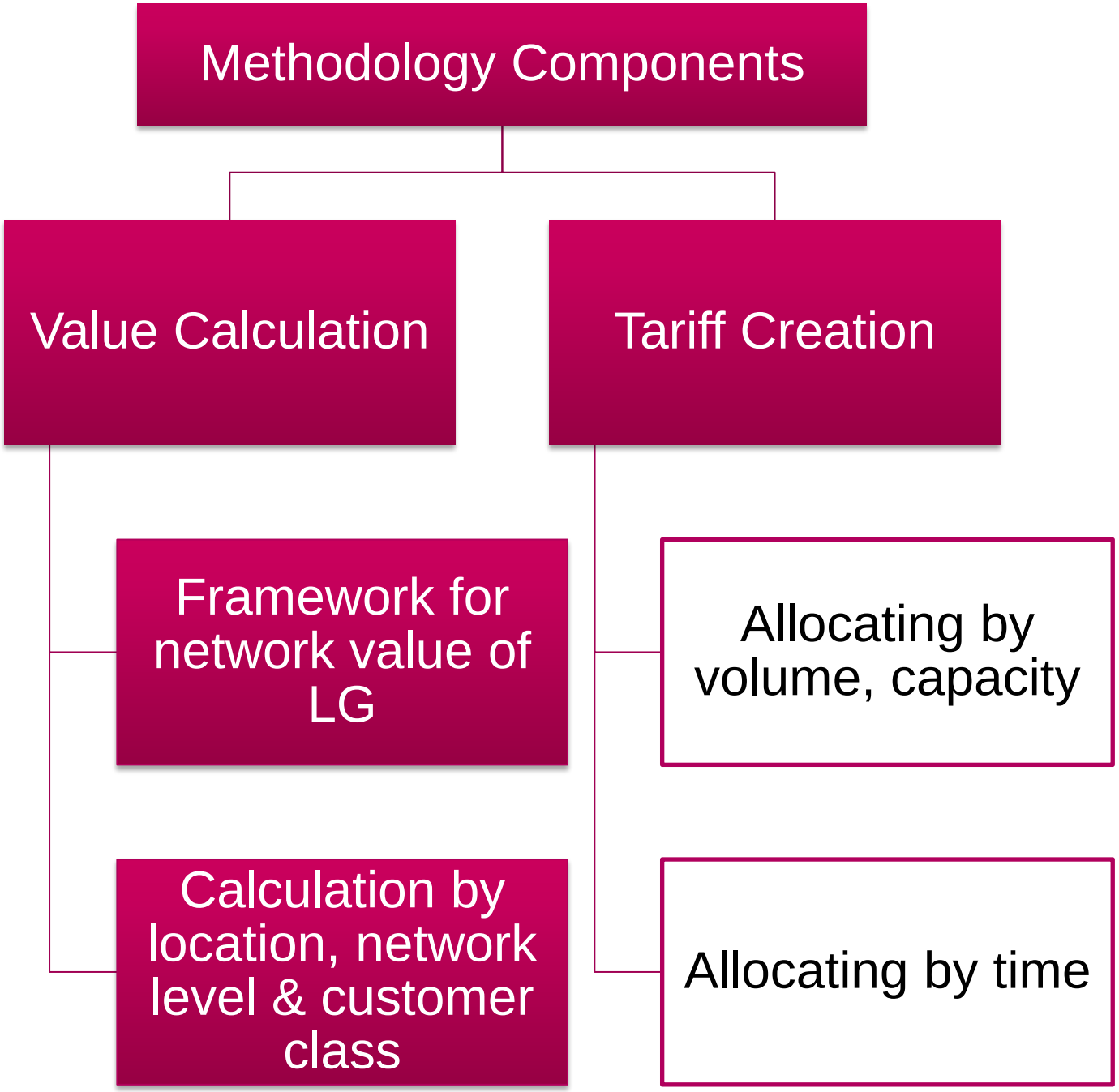
LRMC ($/kVA/yr)	Residential customers	Small commercial customers	Large commercial customers
Transmission	50	50	50
Subtransmission	24	24	25
HV Substation (Zone Substation)	33	33	27
HV Feeder	60	69	57
Distribution Sub	57	48	33
LV	104	93	0
TOTAL	**328**	**307**	**192**

LRMC CALCULATION BY LOCATION, LEVEL, CLASS

- Calculate by same location, level, class as NSPs do now then allocate levels by:

Table 4 Components of LRMC forming LG local network credit, according to the level of generator connection location (credited components marked with a tick)

Generator Situation	Cost Category							
	Transmission (TransGrid)	Sub-transmission line	HV Substation	HV System	LV Substation	LV System	System-Fixed	Non-System fixed
Co-Located (Same site)	✓	✓	✓	✓	✓	✓	✗	✗
LV System Connected	✓	✓	✓	✓	✓	✗	✗	✗
LV Substation Connected	✓	✓	✓	✓	✗	✗	✗	✗
HV System Connected	✓	✓	✓	✗	✗	✗	✗	✗
HV Substation Connected	✓	✓	✗	✗	✗	✗	✗	✗
Sub-Transmission Connected	✓	✗	✗	✗	✗	✗	✗	✗


Methodology Components
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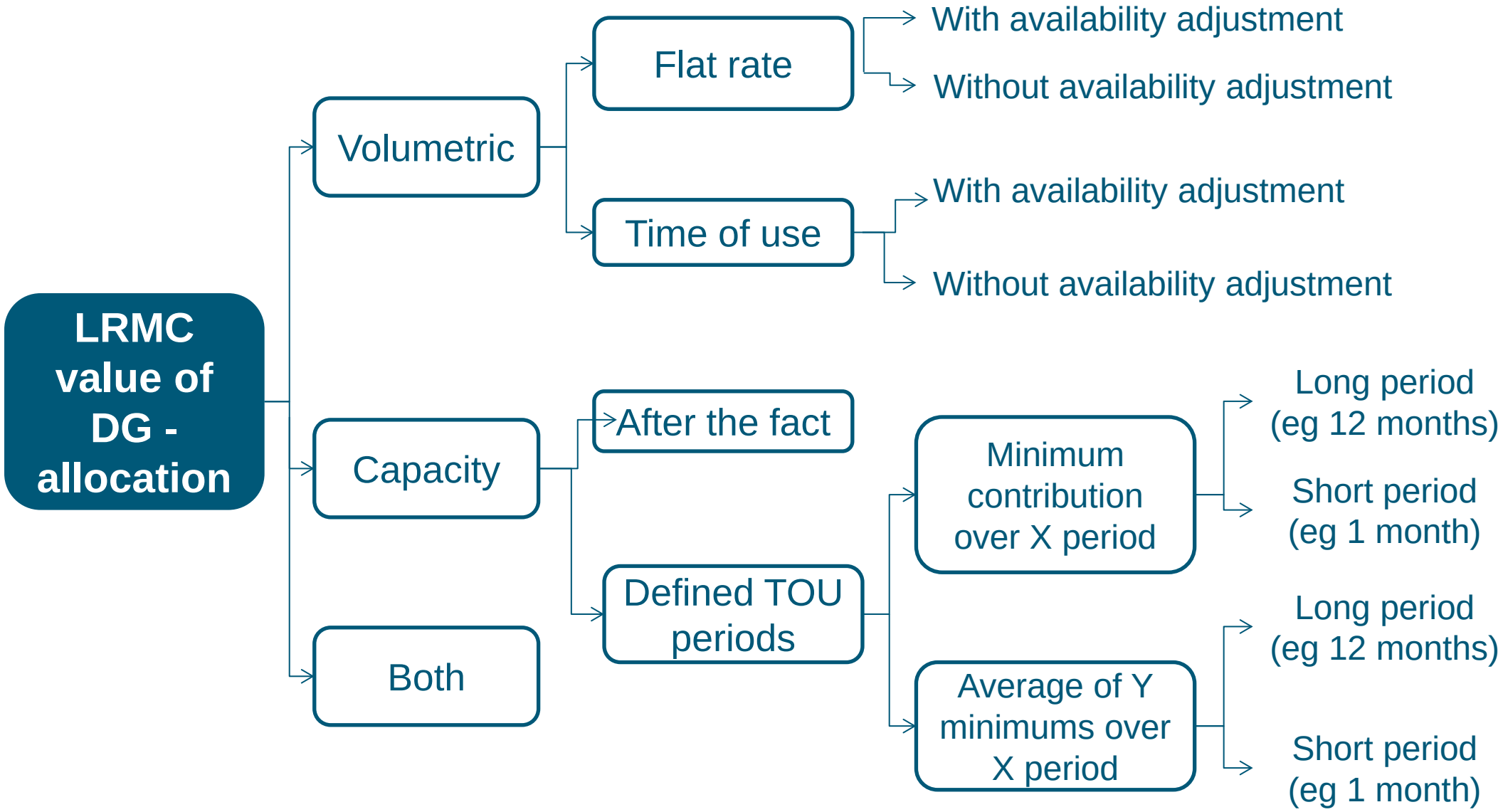
TARIFF CALCULATION CONSIDERATIONS

VOLUME OR CAPACITY: DECISIONS



LGNC TARIFFS INCLUDED IN TRIALS

1. **Volumetric only (Method 1)**
2. **Combined volume-capacity (Method 2)**

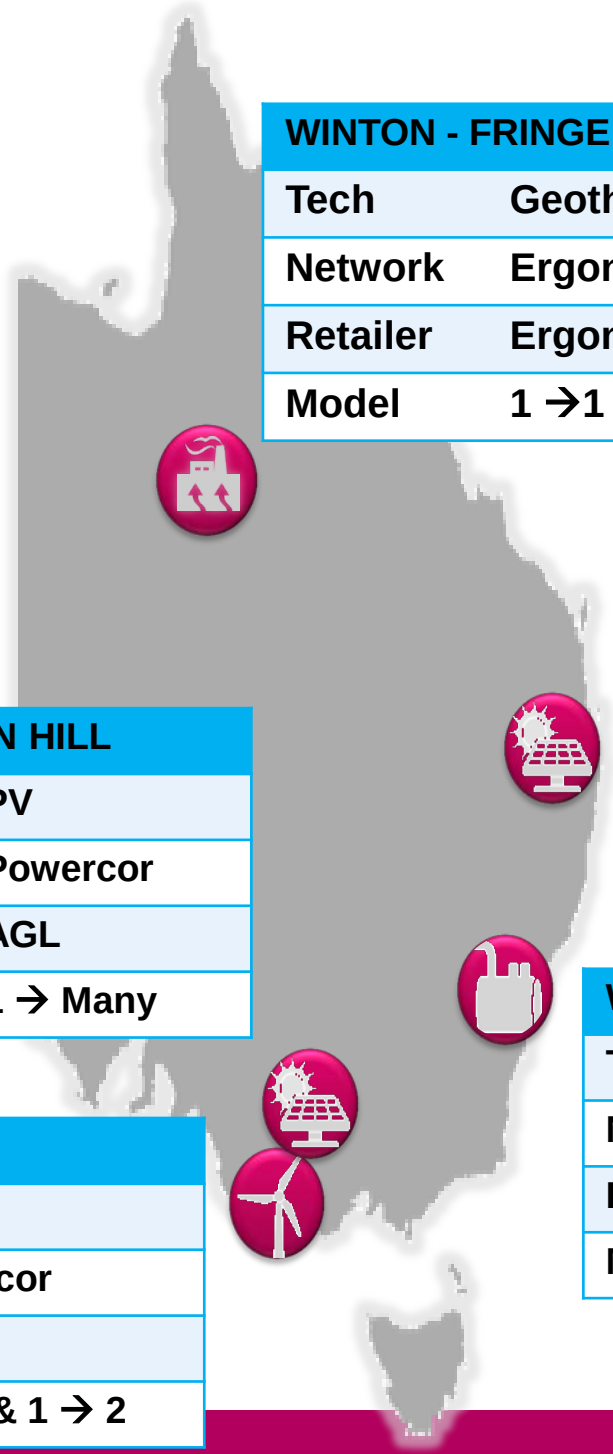
BECAUSE:

- International precedents = volumetric
- Volume-capacity more aligned with CRNP direction
- Allows comparison between volumetric and volume-capacity

WHAT THE TRIALS ARE TELLING US – PRELIMINARY LNC VALUES

virtual

THE TRIALS



WINTON - FRINGE OF GRID	
Tech	Geothermal
Network	Ergon Energy
Retailer	Ergon Energy
Model	1 → 1

BYRON	
Tech	PV
Network	Essential
Retailer	Origin Energy
Model	Council 1 → 1

MOIRA/SWAN HILL	
Tech	PV
Network	Powercor
Retailer	AGL
Model	1 → Many

WILLOUGHBY	
Tech	Cogen + PV
Network	Ausgrid
Retailer	Energy Australia
Model	Council 1 → 1

WANNON WATER	
Tech	Wind
Network	Powercor
Retailer	AGL
Model	1 → 1 & 1 → 2

TRIAL RESULTS – CAVEATS

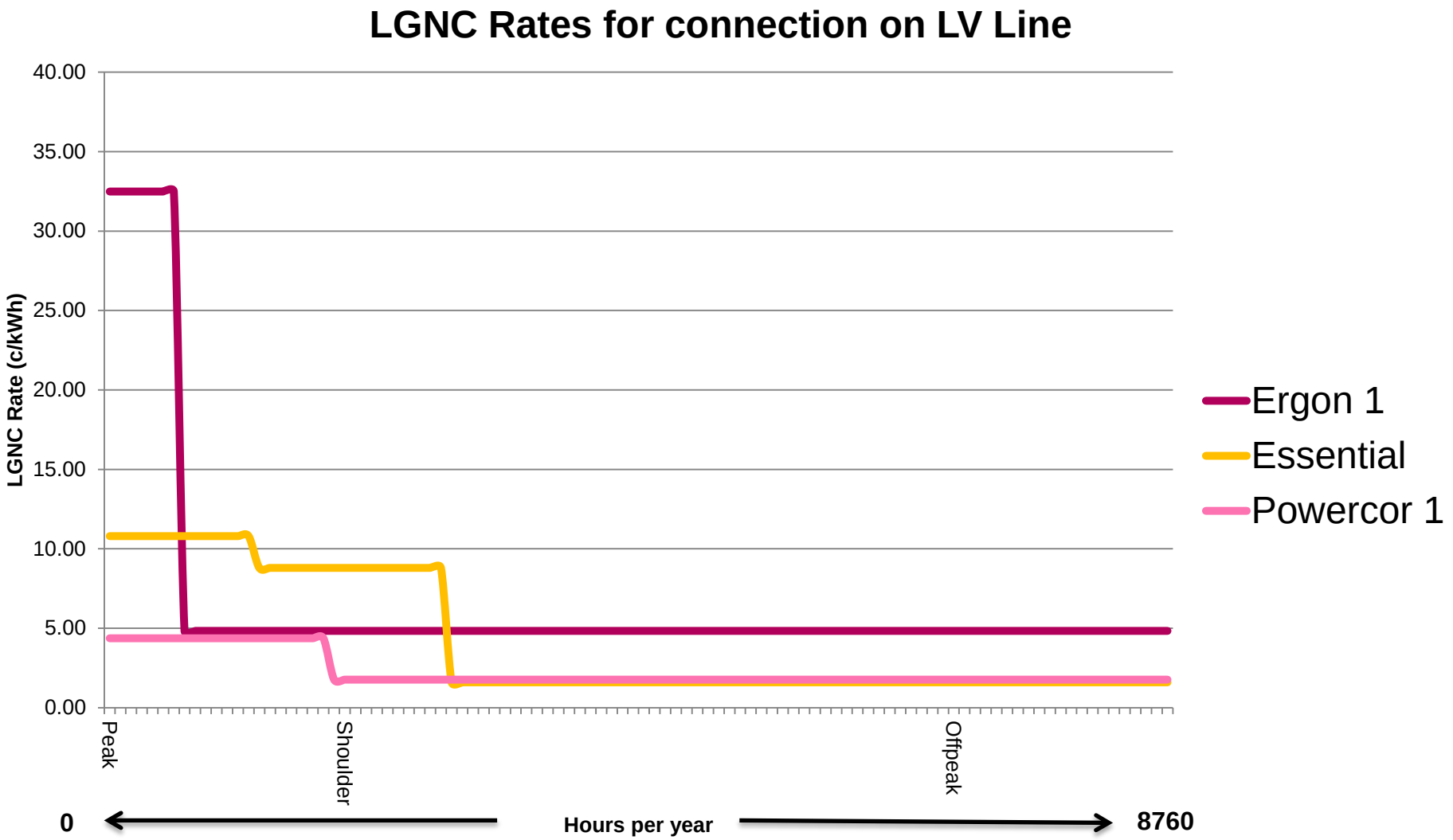
- These results are **preliminary**, as our trial partners have not had time to review thoroughly. We expect final results at the end of April.

- Ergon, Powercor and Essential have made a very valuable contribution to these results and the development of the LNC methodology, **but do not necessarily endorse** the methodology, or the proposed rule change

- LNC values will **vary considerably** by NSP, geographic location and network level, and these results are specific to the situation of each trial.

- The analysis doesn't factor in the impact to local energy flows in terms of capacity, voltage and protection, whether adverse or beneficial.

LGNC VALUES ACROSS THE TRIALS – VOLUMETRIC ONLY METHOD (PRELIMINARY RESULTS)



LNC VALUES ACROSS THE TRIALS – VOLUMETRIC ONLY METHOD (PRELIMINARY RESULTS)

	ERGON			POWERCOR			ESSENTIAL		
Connection level	LVL	LVD	ZS	LVL	LVD	ZS	LVL	LVD	ZS
	c/kWh			c/kWh			c/kWh		
Peak	32.5	28.3	15.4	4.4	4.3	3.0	10.8	8.5	6.5
Shoulder							8.8	6.9	5.3
Off-peak	4.8	4.2	2.3	1.8	1.7	1.2	1.6	1.3	1.0

LNC VALUES ACROSS THE TRIALS – COMBINED METHOD (PRELIMINARY RESULTS)

	ERGON			POWERCOR			ESSENTIAL		
Connection level	LVL	LVD	HV	LVL	LVD	HV	LVL	LVD	HV
VOLUMETRIC PORTION	c/kWh			c/kWh			c/kWh		
Peak	16.2	14.2	7.7	5.6	5.5	3.8	4.9	3.8	2.9
Shoulder							4.0	3.1	2.4
Off-Peak	2.4	2.1	1.1	0.1	0.1	0.1	0.7	0.6	0.4
CAPACITY PAYMENT	$/kW/day			$/kW/day			$/kW/day		
Based on minimum generation in defined period	3.35	2.92	1.59	0.46	0.45	0.31	0.71	0.55	0.42

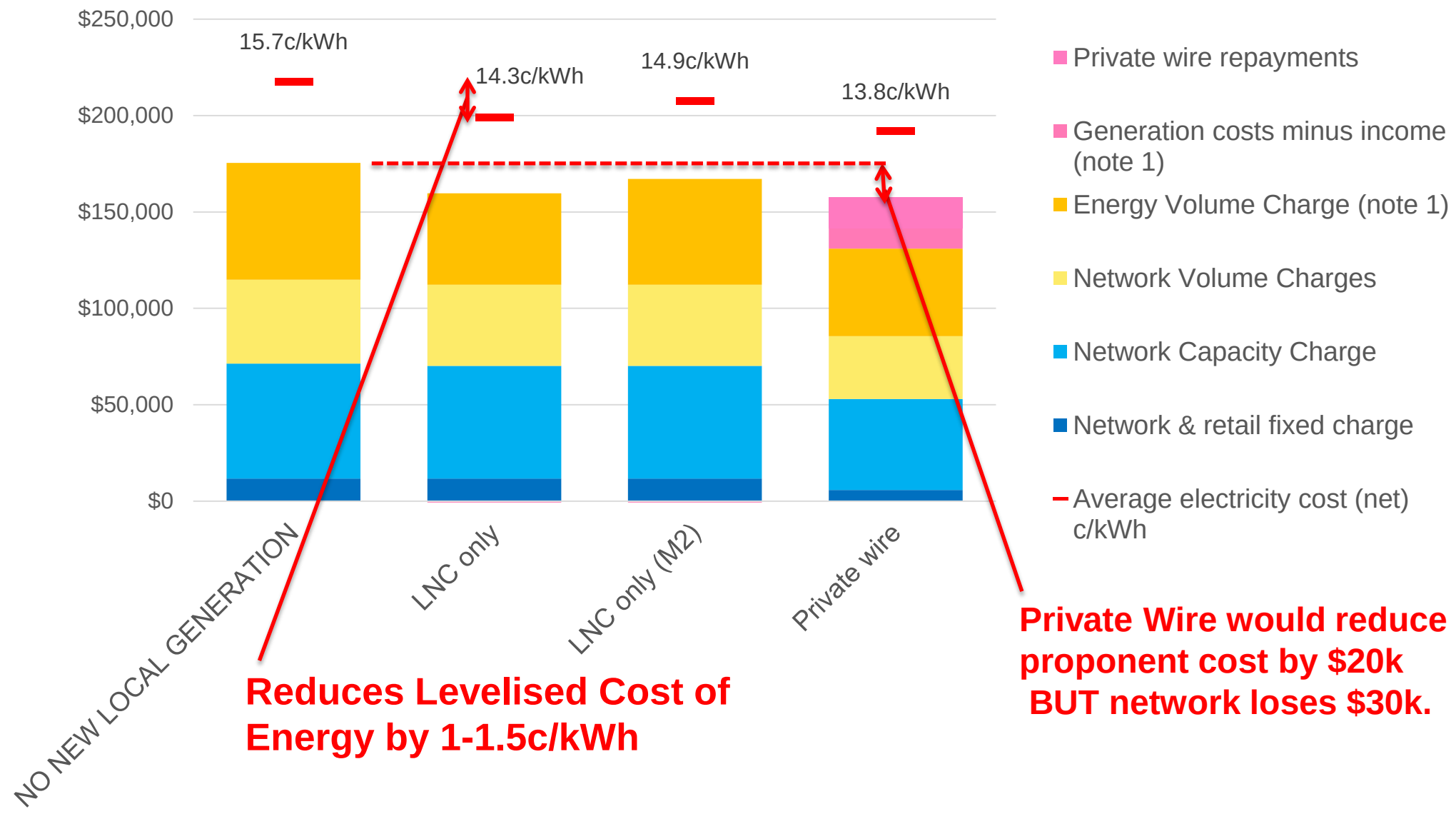
LNC OUTCOMES FOR THE TRIALS (PRELIMINARY RESULTS)

	Winton		Wannon		Byron	
Network	Ergon		Powercor		Essential	
Technology type	Geothermal		Wind		Solar	
Size	310 kW		800 kW		150 kW	
Connection level	High Voltage		LV Distribution Tx		LV Line	
	Method 1	Method 2	Method 1	Method 2	Method 1	Method 2
Annual value (trial)	$65,700	$70,100	$46,700	$23,000	$13,600	$6,100
Value per kW (100% CF)	$286	$286	$192	$192	$469	$469
Value per kW (trial)	$212	$226	$151	$74	$91	$41
Notional availability	74%	79%	30%	15%	19%	9%

WHAT THE TRIALS ARE TELLING US – PRELIMINARY SCENARIO RESULTS

BYRON SHIRE COUNCIL TRIAL: PRELIMINARY RESULTS

ANNUAL ENERGY COST BY SCENARIO



Reduces Levelised Cost of Energy by 1-1.5c/kWh

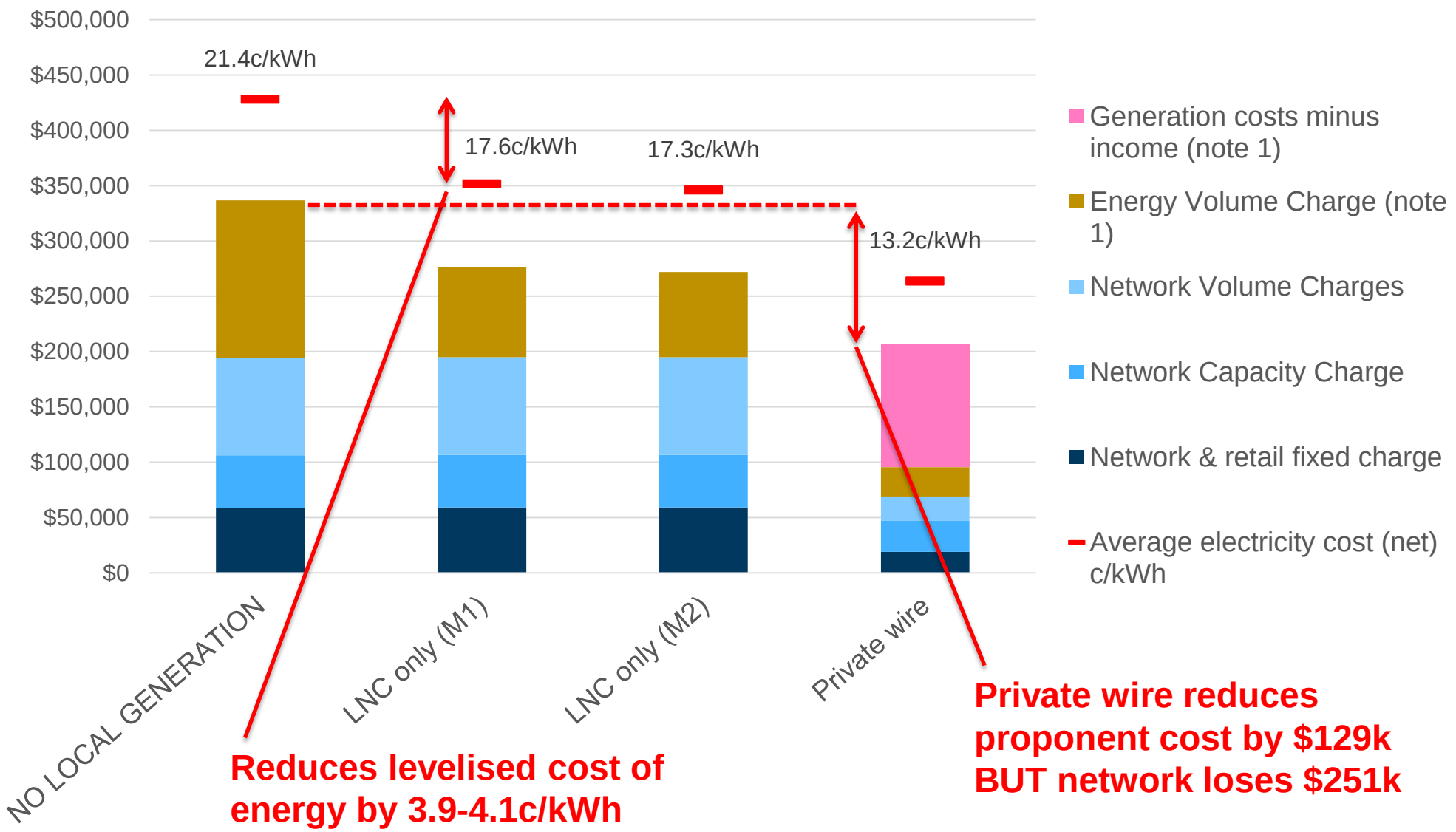
Private Wire would reduce proponent cost by $20k BUT network loses $30k.

SCENARIO OUTCOMES – BYRON SHIRE COUNCIL

	Current market	LNC only (M1)	LNC only (M2)	Private wire
Customer – annual savings compared to BAU	$2,600	$16,200	$8,700	$22,500
LGNC value	-	-$13,600	-$6,100	-
Network business – impact on local charges*	-$2,700	-$16,300	-$8,800	-$29,400

* BAU network charges ~ $115,000

WINTON SHIRE COUNCIL TRIAL: PRELIMINARY RESULTS



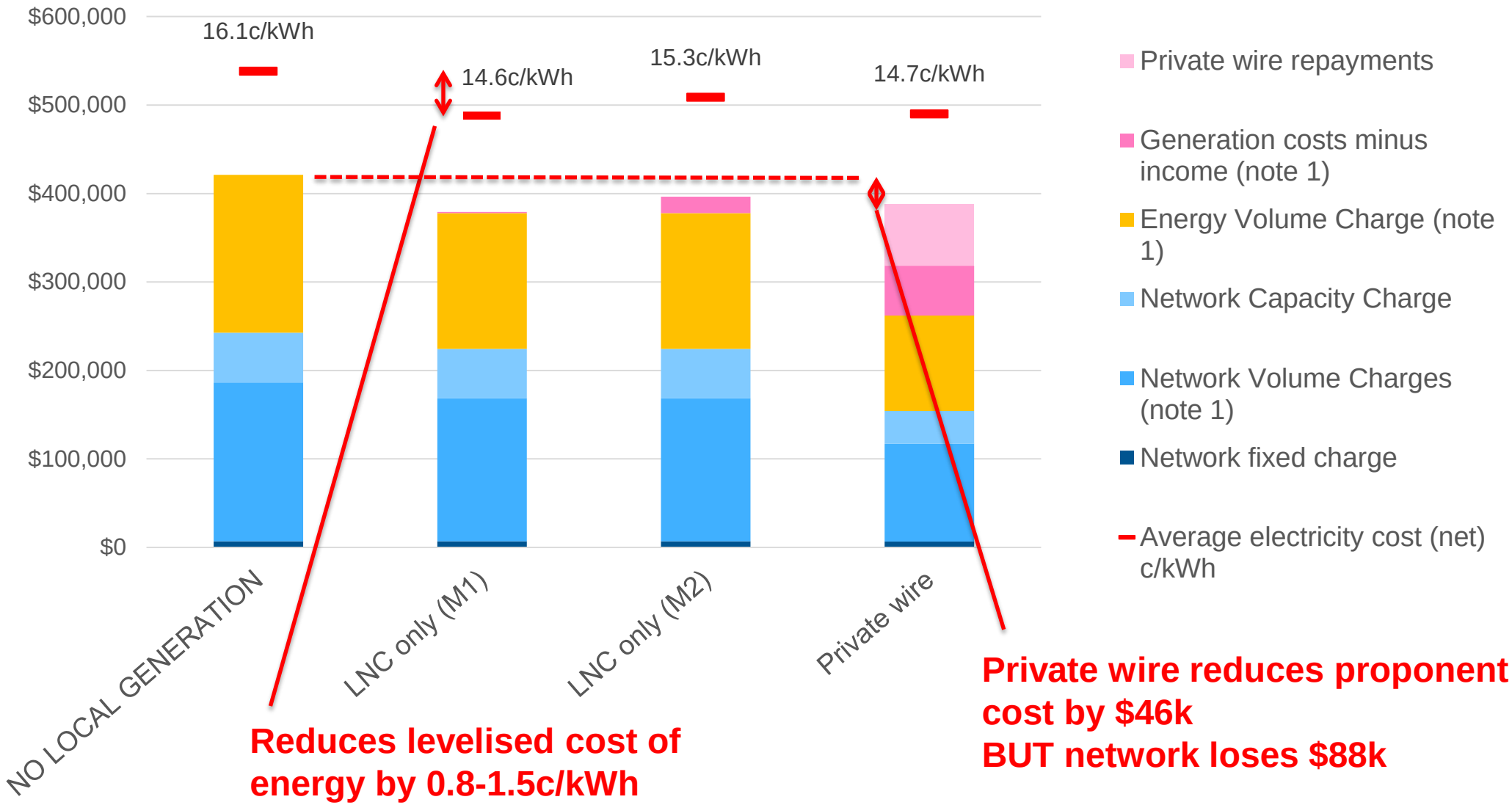
WINTON GEOTHERMAL PROJECT: ANNUAL COST BY SCENARIO

SCENARIO OUTCOMES – WINTON SHIRE COUNCIL

	Current market	LNC only (M1)	LNC only (M2)	Private wire
Customer – annual savings compared to BAU	-$5,500	$60,300	$64,600	$129,300
LGNC value	-	-$65,700	-$70,100	-
Network business impact (local charges) *	$400	-$65,400	-$69,700	-125,485 (charges only) -$251,200 (inc CSO effect)

* BAU network charges ~ $195,000

WANNON WATER TRIAL: PRELIMINARY RESULTS



WANNON WATER AND GLENELG SHIRE COUNCIL: ANNUAL COST BY SCENARIO

SCENARIO OUTCOMES – WANNON WATER TRIAL

	Current market	LNC only (M1)	LNC only (M2)	Private wire
Customer – annual savings compared to BAU	$1,700	$48,300	$24,600	$46,600
LGNC value	-	-$46,700	-$23,000	-
Network business – impact on local charges*	-$18,500	-$65,200	-$41,500	-$88,500

* BAU network charges ~ $224,000

PRELIMINARY CONCLUSIONS

PRELIMINARY CONCLUSIONS

- Incentives to duplicate infrastructure (private wires) are real.
- Private wires lead to worse financial outcome for both the NSP and all consumers.
- Absence of LGNC (network export credit) impedes efficient investment and operational decisions by DG proponents.
- LGNCs tentatively appear to make modest but meaningful contribution to:
  - Dispatchable generator operational strategy
  - DG proponent initial investment decision

PRELIMINARY CONCLUSIONS

- End result of offering LGNC would be to keep kWh **on the grid** (maintain utilisation in increasingly locally derived supply).
- The volume-capacity method (#2) benefits variable DG less than volumetric only method (#1) due to current ‘deterministic’ application.
- Local Electricity Trading would be a **voluntary** offering for retailers (no further Rule Change), potentially unlocked by margin granted by LGNC.

THANK YOU!

Project website

http://bit.do/Local-Energy