

Planning Energy for a Sustainable World

PPA energy

Electricity Wheeling/Transmission Pricing Framework for Jamaica

Training Seminar

PPA Energy

3rd December 2012

Project programme

Schedule of Activities		Week Commencing												
Jamaica Wheeling Charges including cost of service study		22-Oct 1	29-Oct 2	05-Nov 3	12-Nov 4	19-Nov 5	26-Nov 6	03-Dec 7	10-Dec 8	17-Dec 9	24-Dec 10	31-Dec 11	07-Jan 12	14-Jan 13
1	**Review of Regulatory documents and other data**													
1.1	Review relevant documents													
1.2	JPS data review													
1.3	Obtaining and review of documents for cost of service study													
1.4	Inception report													
2	**Review of Wheeling Charge Methods and Recommendation**													
2.1	Compare wheeling charge methodologies													
2.2	Examine cost implications of congestion													
2.3	Examine time of day implications													
2.4	Consider distribution wheeling charges													
2.5	Recommend a wheeling charge methodology													
3	**Methodological report**													
3.1	Prepare methodological report													
4	**Training Session #1**													
4.1	Prepare training session material													
4.2	Deliver training session on wheeling methodologies													
4.3	Approval from OUR on wheeling methodology													
4.4	Regulatory framework discussions													

Today's programme

9:00	Registration	
9:30	Introduction and Aims	
9:45	Introduction to Transmission Prices / wheeling	• Purpose of transmission prices • Transmission pricing principles
10:00	Wheeling Charge Methodologies	• Outline of options • Advantages and Disadvantages • Questions
11:00	Coffee Break	
11:30	Discussion: Issues specific to Jamaican system	• Generation • Market conditions • Time of day • Congestion • Distribution • Questions
12:30	Lunch Break	
14:00	Recommended approach for Jamaica	• Wheeling methodology • Approach to model • Data inputs and outputs • Questions
15:00	Tea Break	
15:30	Workshop discussion/break out groups	Advantages and disadvantages of the proposed approach
16:30	Conclusion	Concluding remarks in respect of recommended approach taking account of the discussion
17:00	End	

Outline

- Objectives
- Transmission pricing – Principles
- Transmission pricing methodology – Types
- Review of international practices
- Key influencing factors for Jamaica
- Recommendations

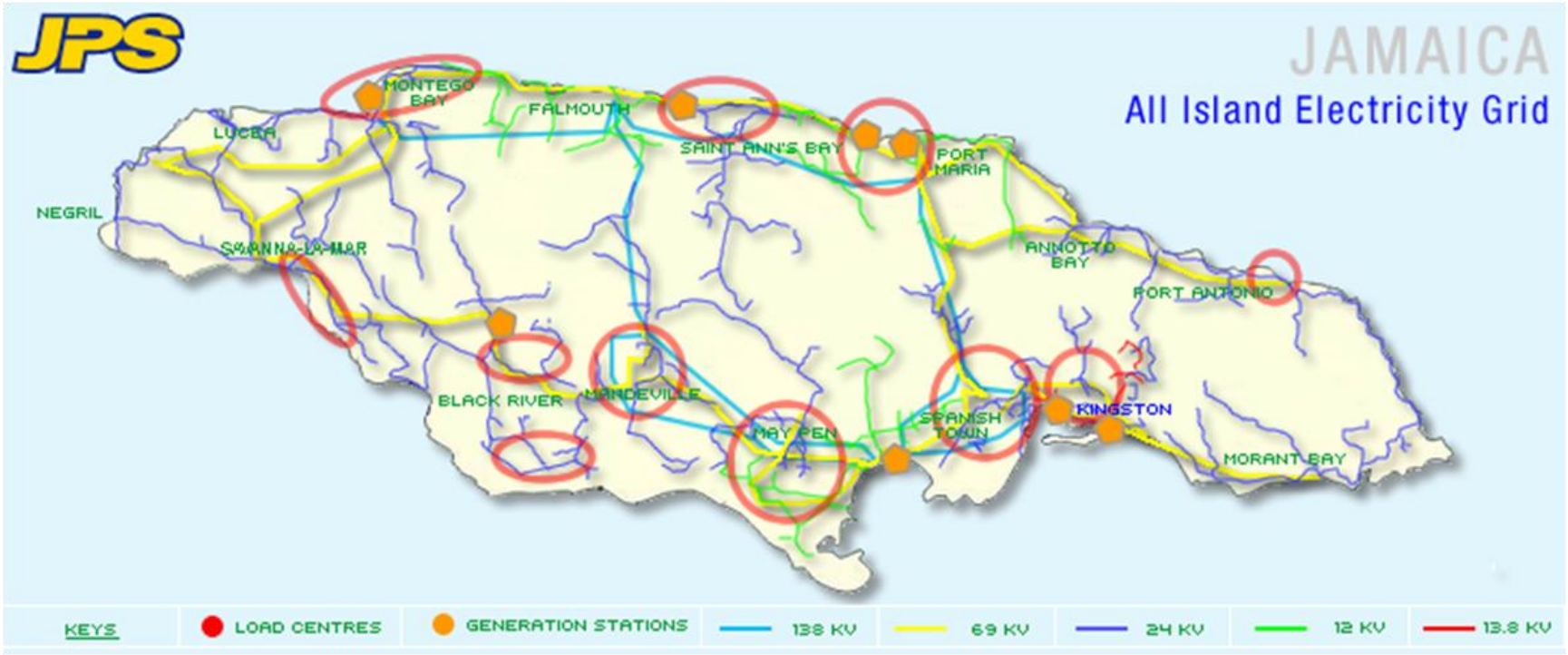
Objectives

- Develop a fair and practical framework for the provision of wheeling services on Jamaica's transmission and distribution network and

- Facilitate regulatory capacity building in relation to wheeling charge methodologies and the computation of transmission and distribution network fees.



The network context



Transmission pricing – Principles

- Promote efficiency
- Recover costs
- Be transparent, fair and predictable
- Be non-discriminatory

Promotes efficiency

- Appropriate price signals to generation and demand
- Incentives for appropriate investment –locational signals
- Promotes competition

Recovers cost

- Security in cost recovery ⟶ Lowered cost of capital
- Incentives for appropriate investment
  - if recovery of cost for appropriate investments is assured
- Different methods available for cost computation
- Historic cost, Future cost (nodal pricing)
- Transmission prices can recover
  - capital costs,
  - O&M costs,
  - losses
  - congestion

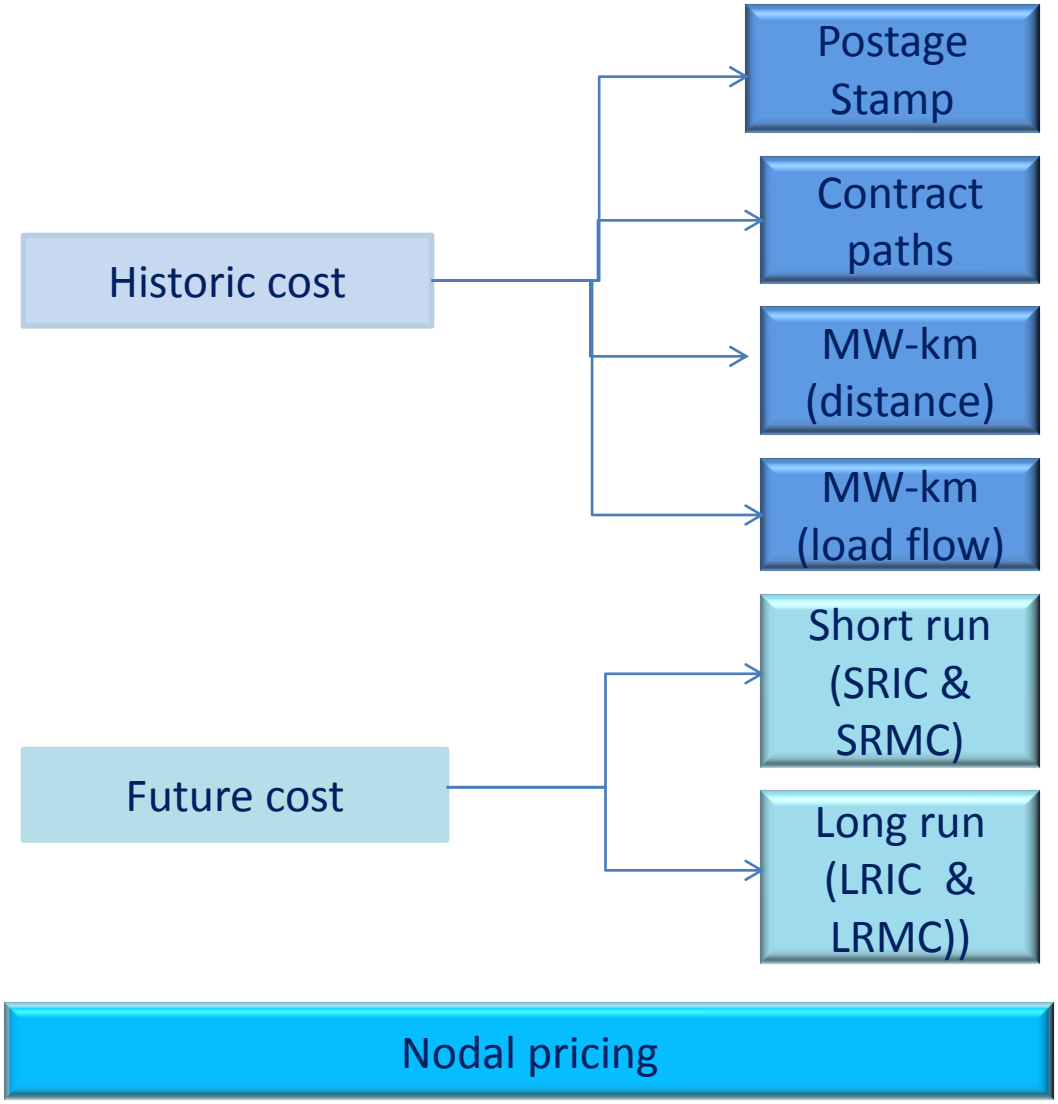
Be transparent, fair and predictable

- Encourage new market participants
- Fair
- Stable- immune to ‘price shocks’
- Clear and straightforward to apply

Be non-discriminatory

- Treat the network users equally in non discriminating nature.
- Residual costs are allocated in a fair manner
  - Key issue: balance between user-specific and “socialised” costs

Transmission pricing methodology - Types



Historic costs- Postage stamp

- Method
  - Costs allocation based on the basis of their share of total peak load on the system
- Advantages
  - Full historic cost recovery
  - Clear, simple, stable charges
  - Suitable for non congestion systems, with generation and demand fairly equally spaced
- Disadvantages
  - Does not take into account of utilisation of system, lack of incentive for system users
  - Discriminates low cost users in favour of high cost users

Example: Generation at Montego Bay, Demand at Kingston



Postage Stamp Pricing



Historic costs- Contract paths

- Method
  - Costs based on the specific path agreed for an individual wheeling transaction.
- Advantages
  - Full historic cost recovery encouraging efficient level of investment
  - simple, stable charges
  - An improved ability to signals the costs of decisions of individuals
- Disadvantages
  - Does not take into account of utilisation of system, lack of incentive for system users
  - Potentially discriminates between users
  - Low economic efficiency as it may lead to investments out of contract path as well.

Contract paths



Contract paths



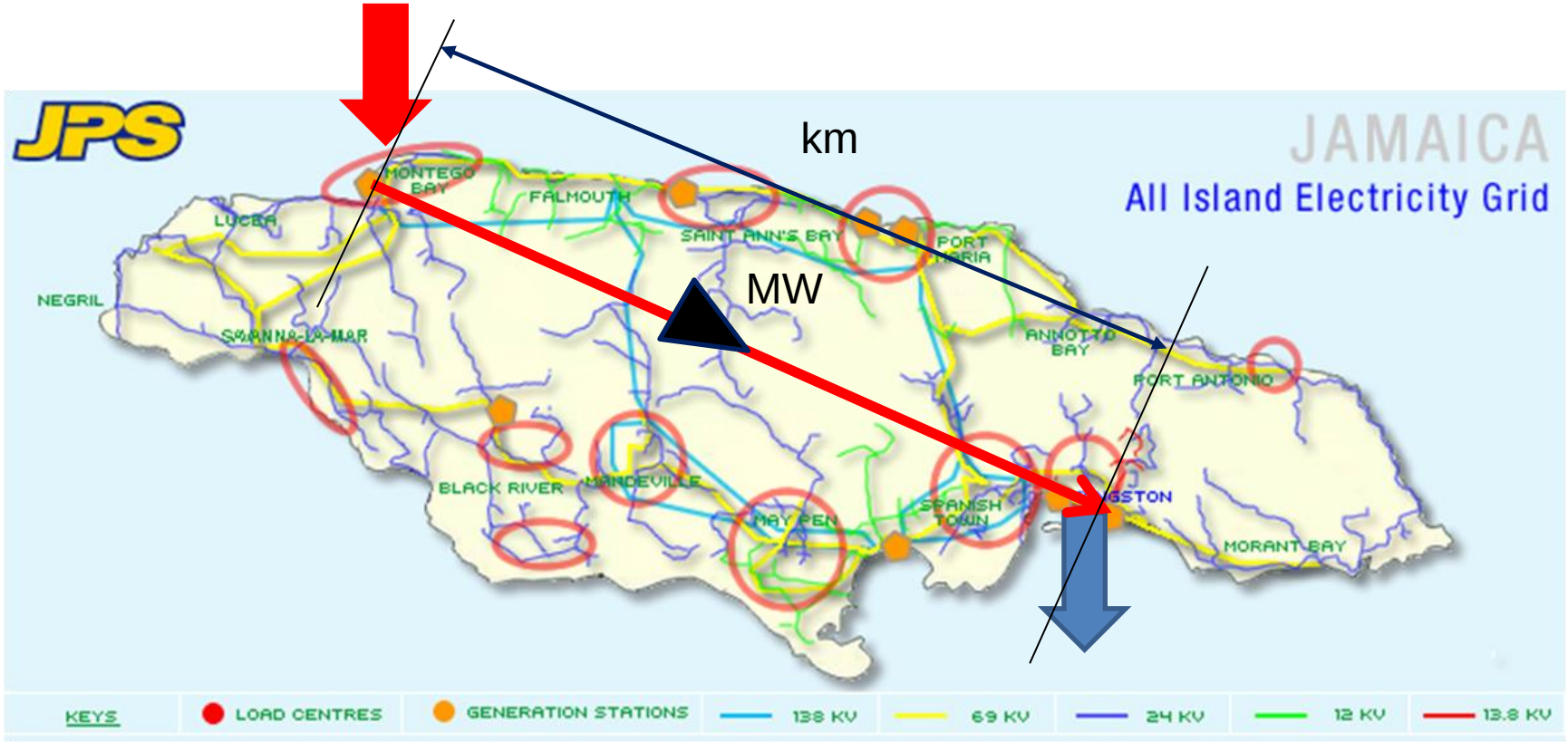
Contract paths



Historic costs- MW-km (distance based)

- Method
  - Distance travelled by the energy in a specific transaction (MW-km) in relation to the total MW-km in the system
- Advantages
  - An improved version of postage stamp and contract path approaches.
- Disadvantages
  - Does not take into account of system costs and actual operation in the system.
  - Does not provide accurate economic signals to users.

MW-km (distance based)



Historic costs- MW-km (load flow based)

- Method
  - Uses power flow model, hence reflects to a better extent, the actual use of the system.
  - Transmission prices reflect the proportion of system use.
- Advantages
  - An improved version of postage stamp and contract path approaches.
  - Simple, clear, stable charges
  - System congestion is starting to be taken into account
- Disadvantages
  - As power flows are less than circuit capacity fails to recover full capital costs.
  - Does not provide correct economic signals to users for future investments.

MW-km (flow-based)



Forward looking – Short run pricing

- SRIC (Short Run Incremental Cost)
  - Short run incremental operating cost
  - Uses a model of optimal power flows
- SRMC (Short Run Marginal Cost)
  - The marginal cost of extra use of transmission system
  - The marginal operating cost of an extra MW
- Disadvantages of short run methods
  - Difficult to estimate the operating cost of a single transaction while multiple transactions are occurring simultaneously
  - Requires future forecasting , the accuracy of which can become decreasingly accurate
  - Data volatility in the short run can result in under investment
  - Additional disadvantages of SRMC method

Forward Looking – Long run pricing

- LRIC and LRMC (Long Run Incremental Cost and Long Run Marginal Cost)
  - Both take into account of investment cost, in addition to incremental operating cost
  - Full long term costs including new investments
  - More stable prices compared to short run

- Disadvantages of long run methods
  - Difficult to estimate the operating cost of a single transaction while multiple transactions are occurring simultaneously
  - Double counting of investment requirements

Nodal pricing

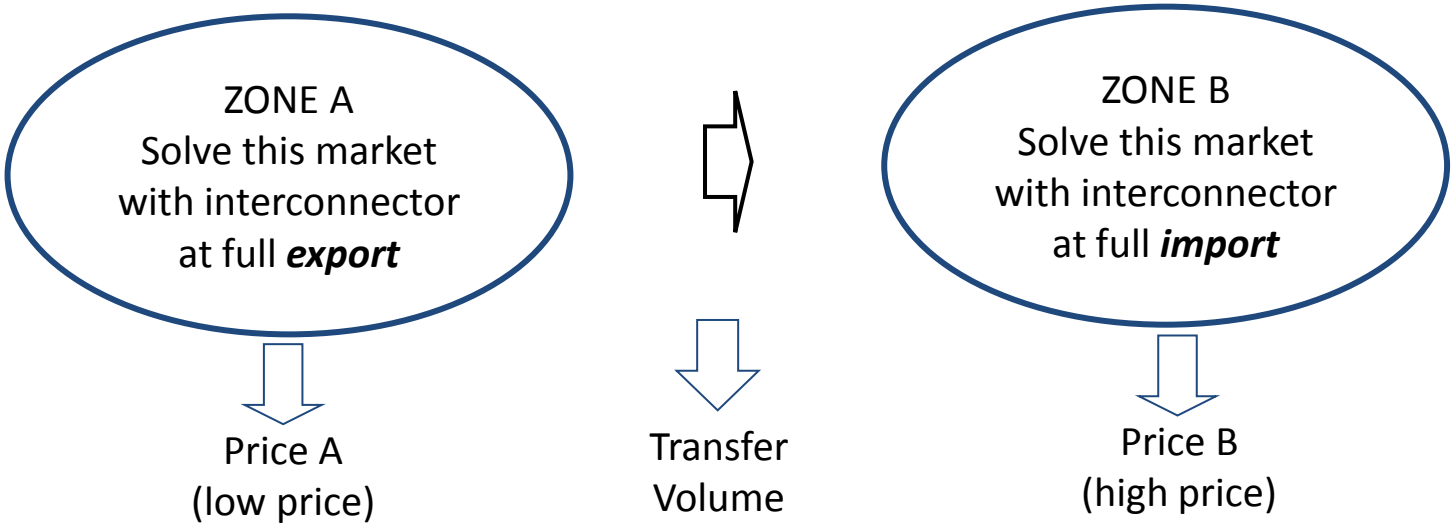
- Method
  - Nodal charges vary at nodes depending on marginal cost of losses and congestion at that node
- Advantages
  - Economically ideal transmission prices
  - Ensures optimal dispatch thus maximizing allocative and dynamic efficiency
- Disadvantages
  - Possible under recovery of fixed costs due to marginal pricing
  - Requires constant real time information about loads, generators, bids and condition of the equipment.
  - Potential Instability and complexity in methodology implementation

Nodal pricing



Congestion management

Market Splitting to manage congestion constraint between areas A & B



Congestion Price = (Price B – Price A)

Congestion Rent = Congestion Price * Transfer Volume

Transmission pricing - International examples

- Nord Pool
- Ireland
- Southern African Power Pool (SAPP)
- Great Britain
- United states: PJM
- New Zealand
- Brazil

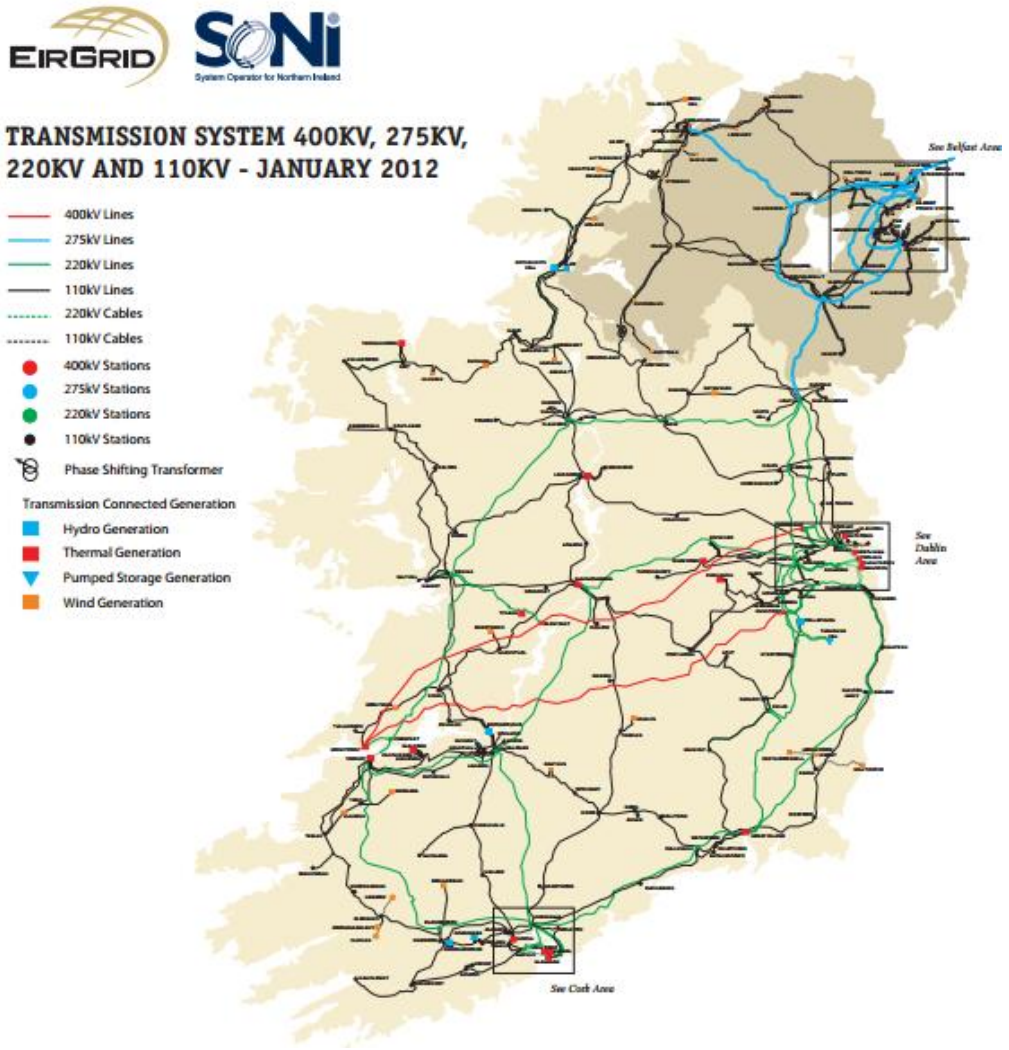
Nord pool transmission zones



International examples: **Nord Pool**

- Nord pool covers six countries in Europe: Denmark, Finland, Sweden, Norway, Estonia and Lithuania.
- Each country has its own TSO and often has more than one market areas.
- Nord pool spot market operates 14 market areas in six countries.
- Nord pool has Point or stamp tariff system
- Producers and consumers pay a fee for the kWh injected or drawn.
- Distance between the countries does not impact the prices.
- Each country has its own transmission tariff for within the country transactions. i.e in Norway, transmission charges include fixed, load and energy components.
- Each country has a different way of allocating charges between consumers and producers.
- Transmission losses (Elspot) – recovered by a standard trading fee Eur/MWh, paid by both buyers and sellers

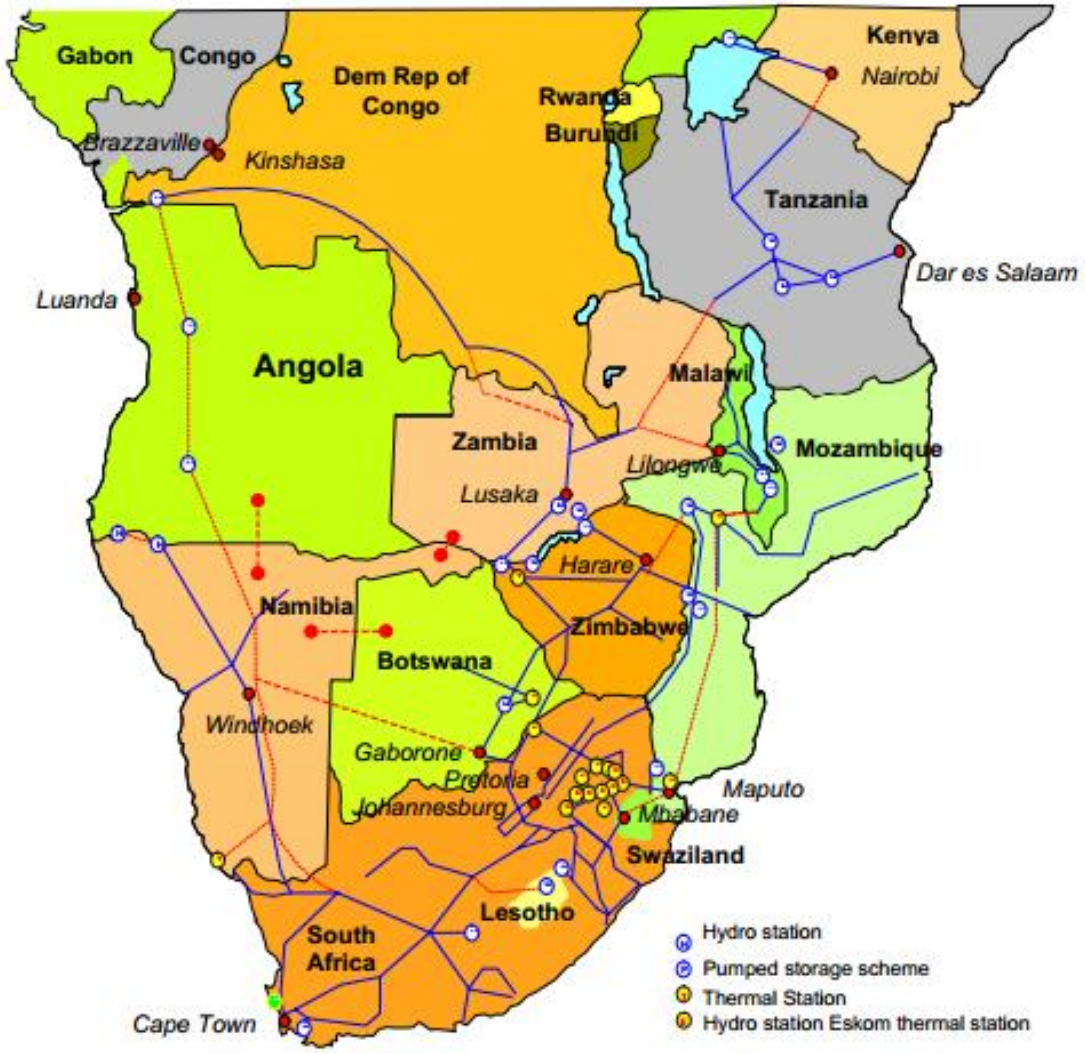
Ireland-All Island transmission system



International examples: **Ireland**

- Eirgrid is the TSO for Republic of Island (RoI) and SONI is the System Operator for Northern Ireland (NI)
- SEMO (Single Electricity Market Operator) operates the centralised gross pool/wholesale market.
- Transmission costs allocated 25:75 between generation and demand
- All island generator transmission tariff recovers 30% from locational element and 70% from a postage stamp element.
- Losses allocated to generators and interconnectors by Transmission Loss Adjustment Factors (TLAF)

SAPP transmission system



International examples: **SAPP**

- SAPP includes utilities and ministries in energy use in 11 countries: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zaire, Zimbabwe and South Africa.
- In 2003, SAPP moved from postage stamp to MW-km (load flow) methodology.
- In 2005, Plans to move to Nodal pricing did not go ahead due to various factors.
- Sophisticated Day Ahead Market (DAM) facilitates trading across interconnectors in real time.
- SAPP region is split into market zones that can split as constraints become binding on the interconnectors.

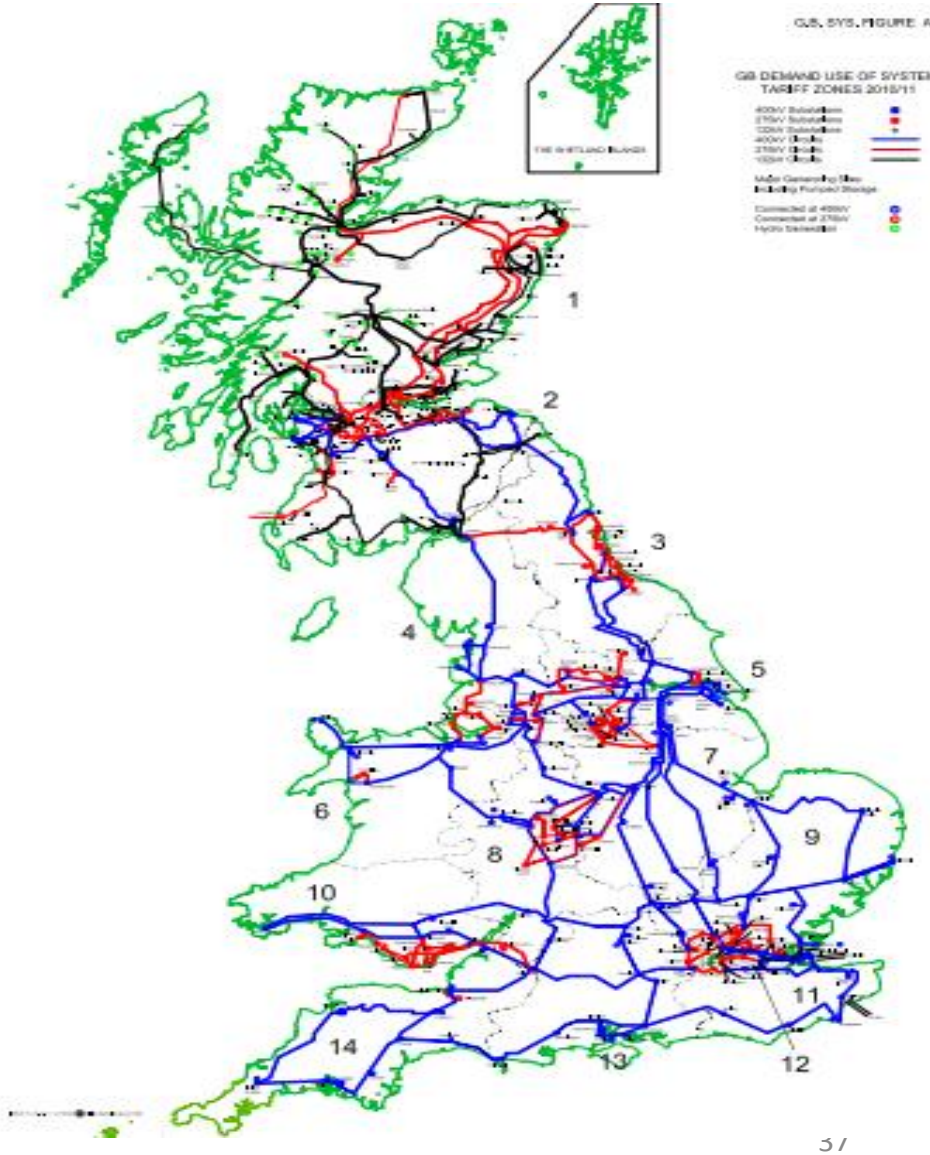
International examples: **Great Britain**

- National Grid is the System Operator in Great Britain (England, Scotland and Wales)
- GB transmission system is divided into 14 demand zones and

  20 generation zones
- Transmission charges based on nodal pricing that uses DCLF (Direct Current Load flow) ICRP (Investment cost Related Pricing)
- Charges reflect the incremental cost in addition to locational factor
- Transmission costs are allocated at 27:73 split between generation and demand
- Transmission losses recovered via energy market, through loss factor application

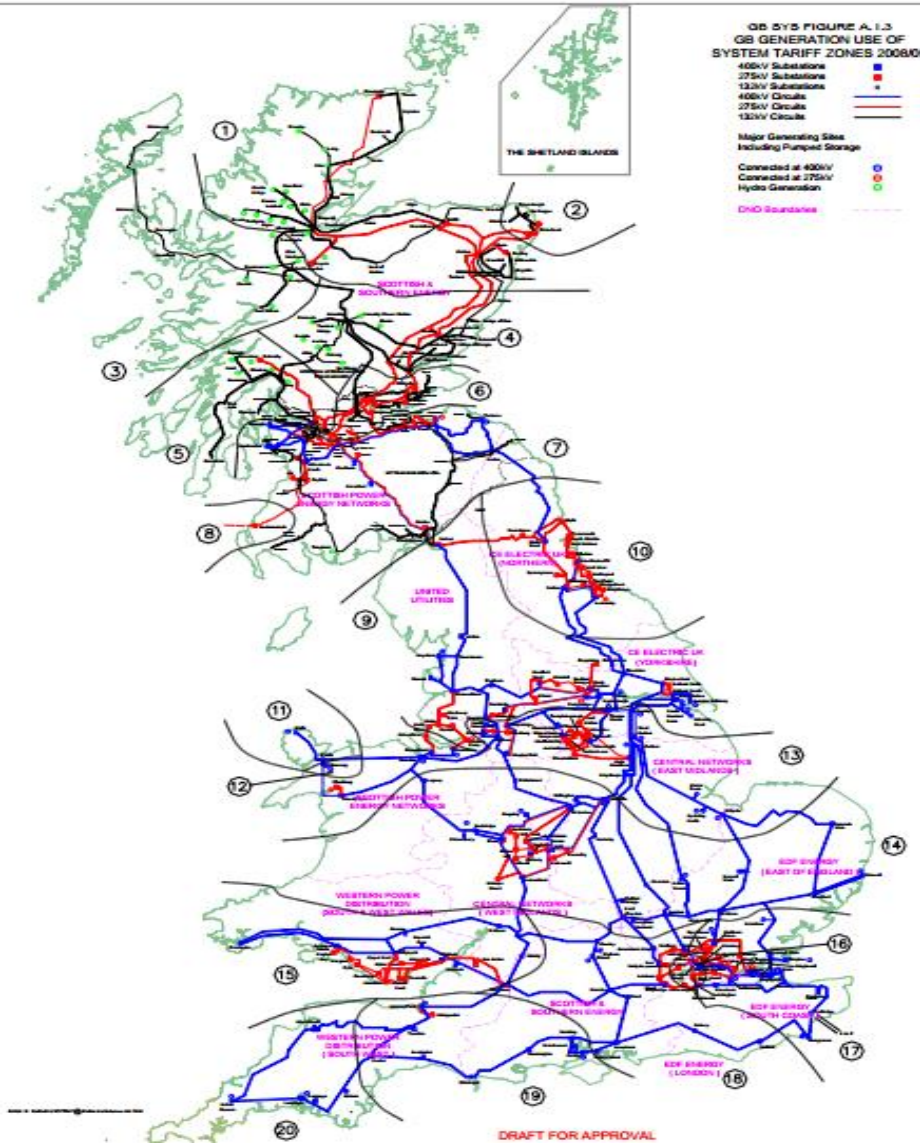
Great Britain – Demand zones

Demand Zone	Zone Area	Demand Tariff (£/kW)	Energy Consumption Tariff (p/kWh)
1	Northern Scotland	10.741418	1.481661
2	Southern Scotland	16.001744	2.260958
3	Northern	19.662769	2.720973
4	North West	22.838742	3.310579
5	Yorkshire	23.180244	3.216258
6	N Wales & Mersey	23.639502	3.392395
7	East Midlands	25.451532	3.602558
8	Midlands	27.358246	3.936288
9	Eastern	25.952047	3.633328
10	South Wales	25.257265	3.368021
11	South East	28.248124	3.987297
12	London	31.174616	4.169758
13	Southern	30.613447	4.343659
14	South Western	31.062748	4.226735

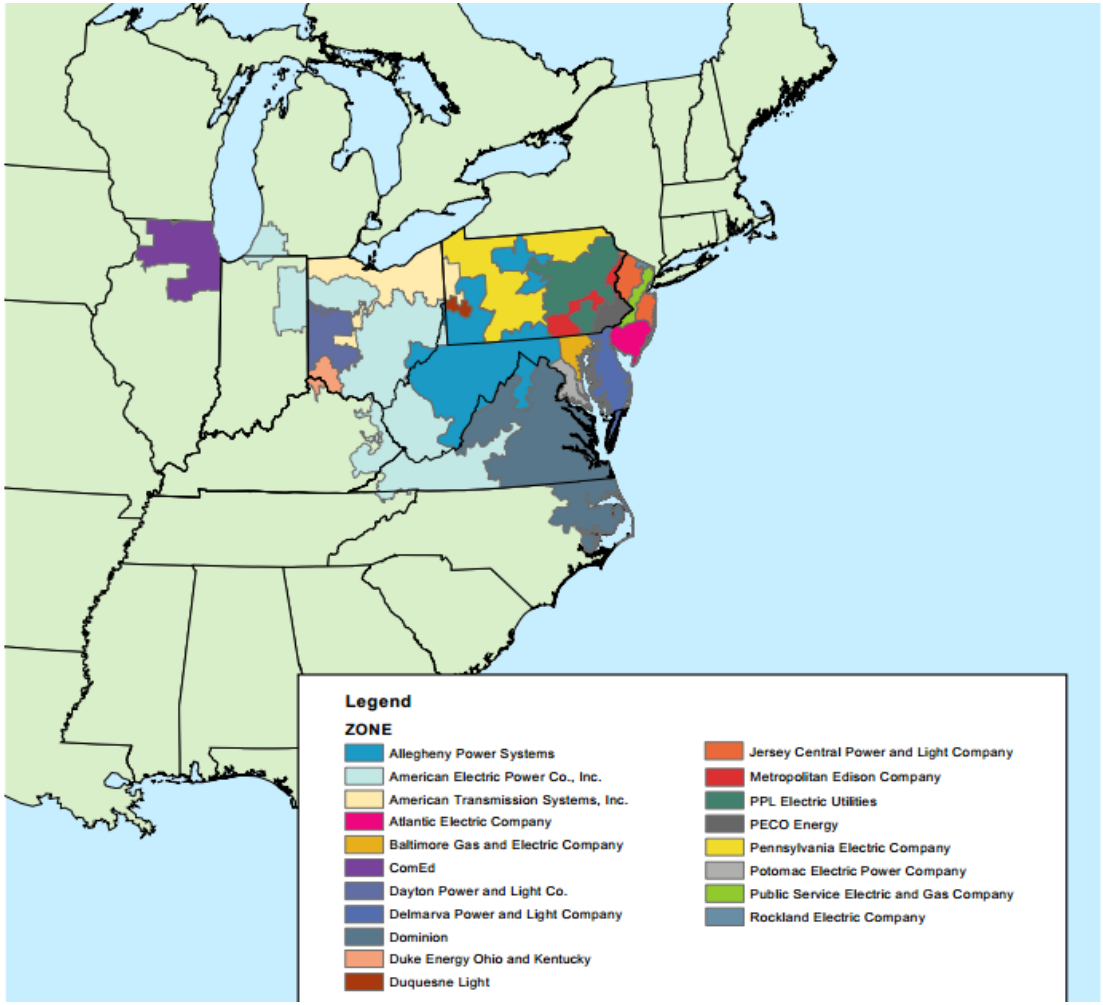


Great Britain - Generation zones

Zone	Zone Name	Tariff (£/kW)
1	North Scotland	21.958097
2	Peterhead	20.113140
3	Western Highland & Skye	22.051017
4	Central Highlands	17.560345
5	Argyll	14.187889
6	Stirlingshire	14.227364
7	South Scotland	12.787463
8	Auchencrosh	10.504012
9	Humber & Lancashire	6.078531
10	North East England	8.426476
11	Anglesey	7.099147
12	Dinorwig	6.355495
13	South Yorks & North Wales	4.605096
14	Midlands	2.392870
15	South Wales & Gloucester	2.031854
16	Central London	-13.350709
17	South East	2.324187
18	Oxon & South Coast	-1.108129
19	Wessex	-1.708422
20	Peninsula	-5.676387



PJM transmission zones



International examples: **US (PJM)**

- PJM , a Regional Transmission Organisation (RTO) manages the interconnection between 13 states and District Columbia and a market operator.
- Uses Locational Marginal Pricing (LMP) – reflects value of energy at the specific location and the time of delivery
- Demand pays 100% transmission costs
- PJM Day ahead market – Forward market- Hourly LMPs are calculated based on generation offers, demand bids and scheduled bilateral transactions.
- PJM Real time market- Spot market –real time LMPs calculated at 5 min intervals.
- FTR (Financial Transmission Rights) traded separately from transmission service.
- Cost of transmission losses are reflected in the energy market prices.

New Zealand transmission system



International examples: New Zealand

- TransPower is the system operator covering north and south islands.
- Uses LMP and based on full nodal pricing to calculate transmission costs.
- Loads pay the interconnection charges- weighted average of the regional coincident peak demand
- 100% transmission costs are allocated to the loads.
- NZEM, New Zealand electricity Market operates whole sale electricity market.
- Long term bilateral contracts known as contracts market
- Spot market
- Transmission losses are reflected in the half hourly energy prices.

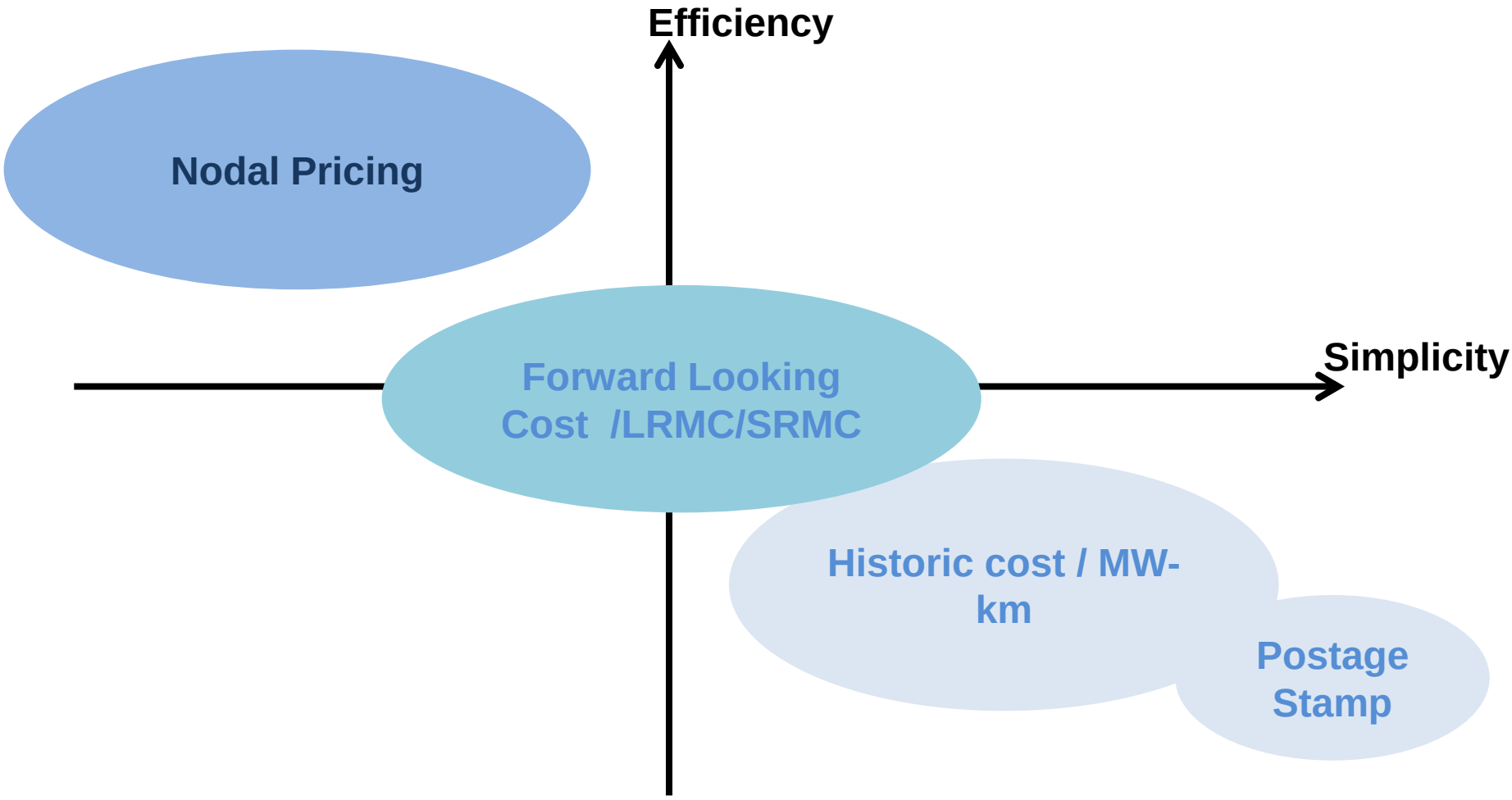
Brazil transmission system



International examples: Brazil

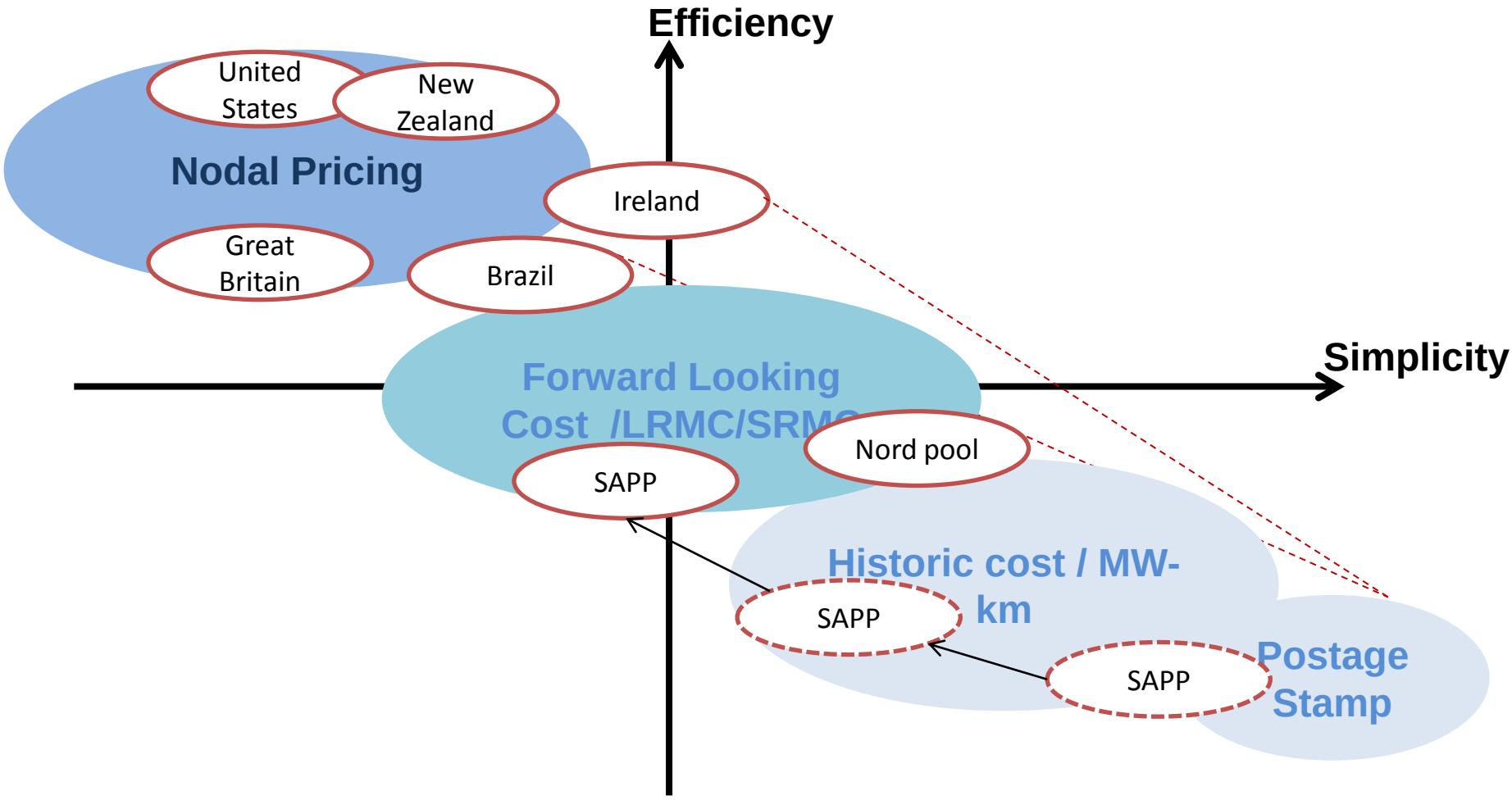
- ONS is the National System Operator in Brazil
- Transmission costs are allocated at 50:50 split between generation and demand.
- Cost recovery- 20% from flow-based calculation and 80% from peak usage charges
- Self producers are charged on nodal basis and charges depends on connection point location and reflect an element of socialised system service charges
- Transmission losses are reflected through the loss factors adjustment. Energy prices reflect marginal loss component .

Methodologies -Trade off between Efficiency and Simplicity



Indicative Only

International examples -Trade off between Efficiency and Simplicity



Indicative Only

Comparison of wheeling methodologies

Method	Efficiency	Cost recovery	Transparency	Stability	Non-discrimination	Ease of application	Total Score
Postage Stamp	✗	✓	✓	✓	✗	✓	2
Contract Path	✗	✓	✗	✓	✗	✓	0
MW-km (distance)	-	✓	✗	✓	✗	✓	1
MW-km (flow-based)	✓	✓	✓	-	✓	-	4
Nodal Pricing	✓	-	✗	✗	✓	✗	-1
SRIC	✓	-	-	✗	✓	-	1
LRIC	✓	-	✓	✓	✓	-	4

Influencing factors

- **Electricity trading rules**:
  - spot market/gross pool vs. bilateral contracts
  - identification of trading counterparties
  - entry/exit charges vs. contract based
  - restriction to self-generators at present
- **Congestion management:**
  - market rules linkage
  - value of signal through T charges
  - importance of significant locational component
  - medium/long term signals of the availability of transmission

Influencing factors

- **Losses:** under all of the methods other than the nodal pricing approach, treated separately from the application of network charges themselves.
  - via a "postage-stamp" approach, allocating the overall cost of losses across all system users; or
  - by identifying the costs arising from the incremental effect of losses arising from specific wheeling transactions.
- **Ancillary Services Costs:** impact of generation required to:
  - balance the network
  - maintain supply quality and security standards
  - provide top-up/standby electricity
- **Cost recovery:**
  - to "socialise" the costs; or
  - include in specific the wheeling agreements

Discussion: Characteristics of Jamaican Power Sector

Impact on charging methodology

Discussion: System Characteristics

- Wheeling asset definitions – what is the wheeling network?
  - voltages, differentiation from connection assets
- Generation and network flows
  - capacities, locations of generation; dominant flow patterns
- Market conditions
  - how many bilateral wheeling trades initially?
  - capacities/volumes/firm access vs. non-firm
- Time of year/time of day
  - effects on power flows
- Congestion
  - areas of networks affected, what is the impact?
- Distribution
  - voltages of connection, connection configurations

JPS Generation (GWh)

	Old Harbour 6	Hunts Bay 6	Rockfort 6	Hunts Bay 2	Bogue 2	Renewables	Total
Jan-11	75.2	35.5	14.5	9.4	75.4	13.8	223.8
Feb-11	76.9	30.3	19.2	2.7	61.1	11.2	201.4
Mar-11	81.2	16.7	27.2	11.4	76	12.7	225.2
Apr-11	65.1	35.6	24.9	14.3	68.3	11.7	219.9
May-11	65.3	34.1	24.2	12.8	77.6	13.1	227.1
Jun-11	66.4	31.4	23.6	11.3	67.8	14.4	214.9
Jul-11	86	35.5	25.4	6.1	69.3	14.7	237.0
Aug-11	82.4	34	27.2	6.7	72.8	14.8	237.9
Sep-11	85.8	36.1	26.2	16	65.3	12.6	242.0
Oct-11	77.7	36.4	25.2	12.3	80	11.7	243.3
Nov-11	67.9	35.1	26	11.8	79	9.4	229.2
Dec-11	68.6	34.4	25.9	7.6	75.1	12	223.6
Total	**898.5**	**395.1**	**289.5**	**122.4**	**867.7**	**152.1**	**2725.3**

IPPs/Self Generation (GWh)

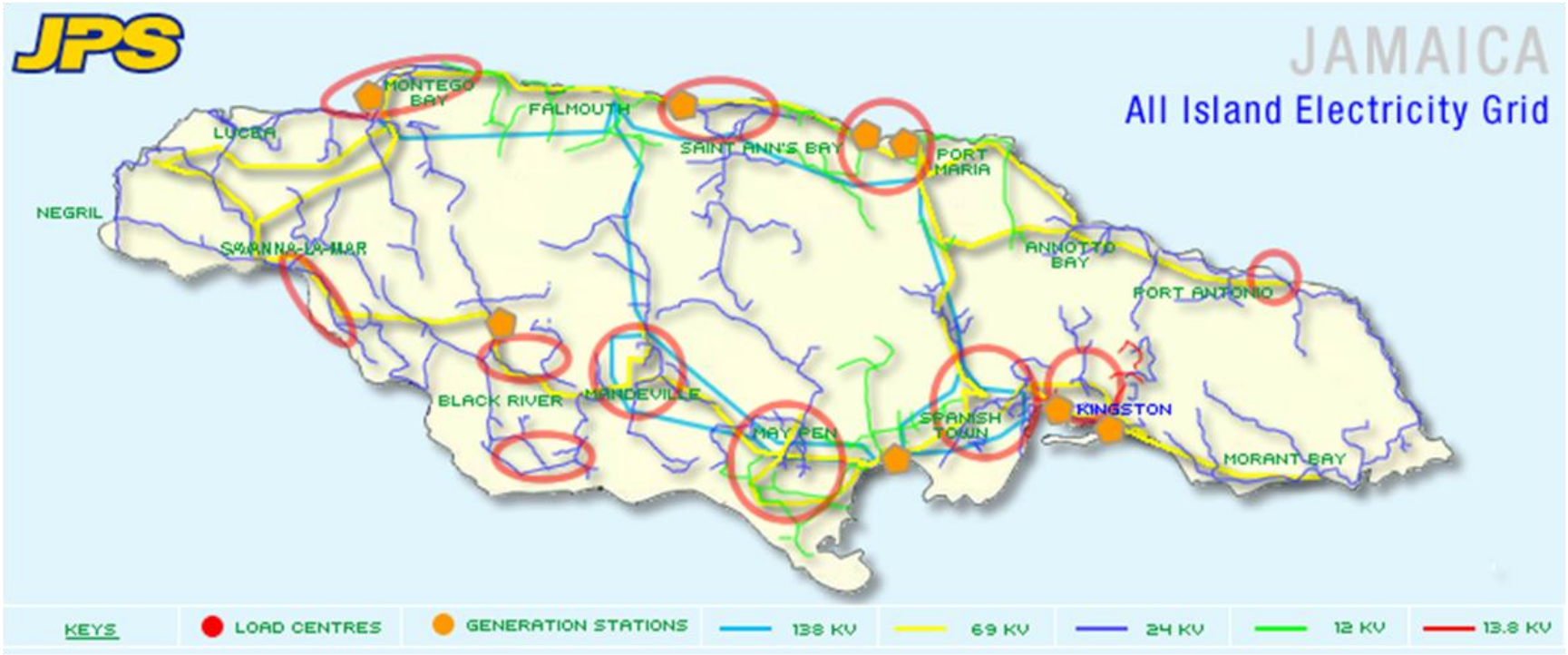
	JAMALCO	JPPC	JEP	WIGTON	ROPECON	JABROILERS	Total
Jan-11	0.05	37.9	72	5.8	0	1.9	117.65
Feb-11	0.037	35.8	62.8	7.8	0	2.6	109.037
Mar-11	0.047	33.4	73.7	8.4	0	3.3	118.847
Apr-11	0.018	34.2	74.8	5.7	0	1.8	116.518
May-11	0.001	38.7	81.7	3.9	0	2.3	126.601
Jun-11	0.002	37	76.5	14.9	0	3.5	131.902
Jul-11	0.041	37.9	70.9	13.9	0.1	2.4	125.241
Aug-11	0.45	42.7	70	7.9	0.087	1.8	122.937
Sep-11	0.55	23.5	76.7	4.8	0.083	1.8	107.433
Oct-11	1.1	28.2	69.4	6.8	0.068	1.8	107.368
Nov-11	0.63	40.3	66.3	4	0.094	1.8	113.124
Dec-11	0.7	37.9	66.9	7.3	0.082	1.9	114.782
Total	**3.626**	**427.5**	**861.7**	**91.2**	**0.514**	**26.9**	**1411.44**

Potential Wheeling energy per annum:	122.24	GWh
Total Energy delivered per annum:	4136.74	GWh
Wheeling volume:	3%	
With IPPs:	34%	

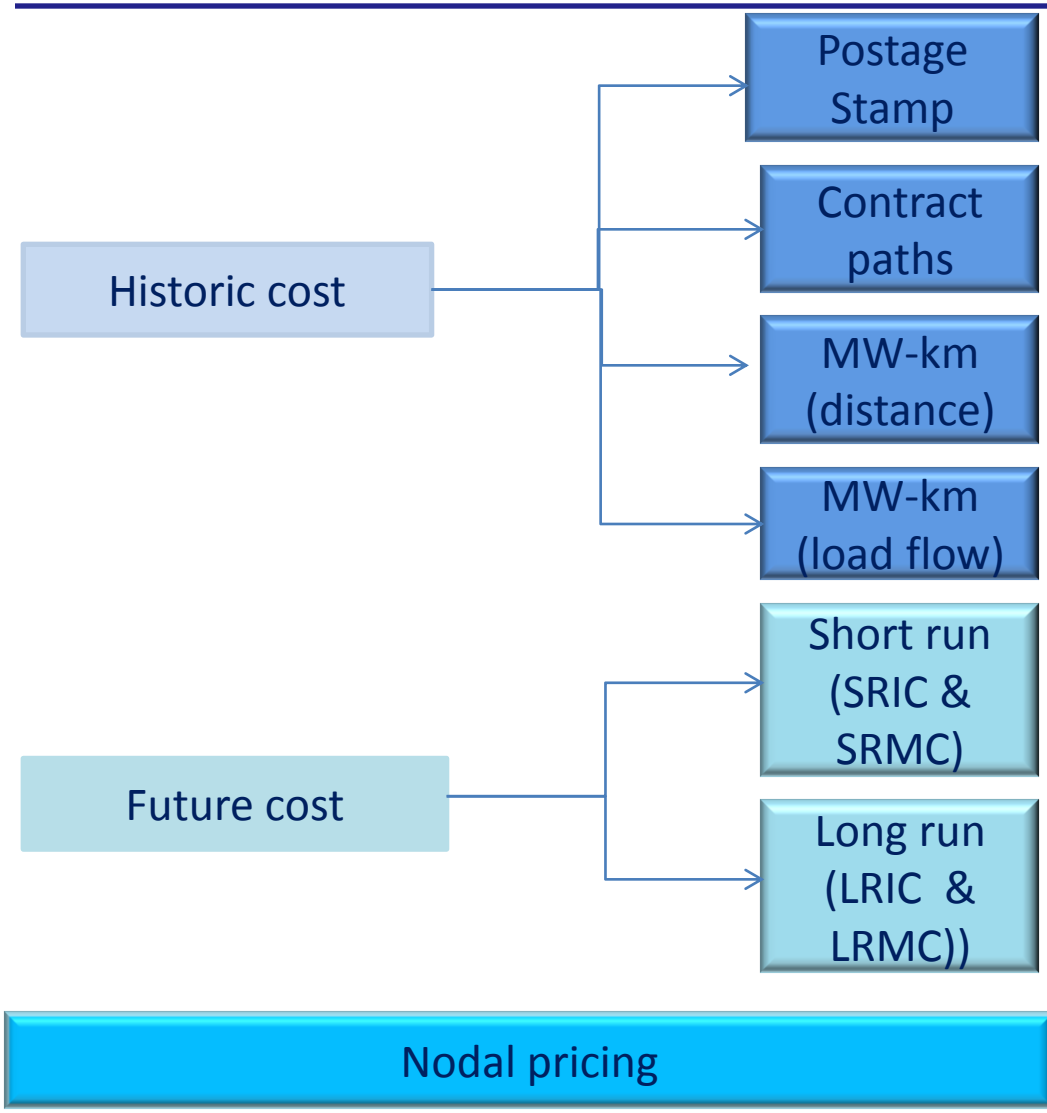
Network characteristics

- Transmission system: 69kV ring, with a central 138kV ring superimposed
- Combination of wheeling routes possible, so power-flow based pricing is likely to be desirable.
- Network is not highly meshed, and limited difference likely in transmission prices at adjacent nodes.
- Distribution networks primarily radial
  - Further work is required to determine the locations within these networks of the typical loads (or indeed generators) that require wheeling services. Because of the radial nature of distribution, however, relatively simplistic pricing of this element of network use is possible.

Network characteristics



Comments on Specific Methods



Transparent

Cost-reflective

Cost recovery

Straightforward to implement

Non-discrimination/fairness

Stability

Recommended Wheeling Methodology

Recommended methodology for Jamaica

- Taking account of...
  - Network characteristics
  - Regulatory context
  - Electricity market background in Jamaica (focus on self-generators)
  - International experience
  - Characteristics of different theoretical methods
  - Tradeoffs in economic efficiency/simplicity
- ...then the MW-km (Flow based) method is recommended
- Advantages:
  - Transparency
  - Assurance of cost recovery of existing asset base
  - Gives locational signals to future wheeling parties
  - Based on actual network flows to measure use of assets

MW-km (flow-based)



Compatibility with regulations

- Key documents reviewed:
  - The OUR Act
  - The All-Island Electric Licence
  - 2009-2014 OUR Tariff Determination Report
  - 2004 Generation Market Study

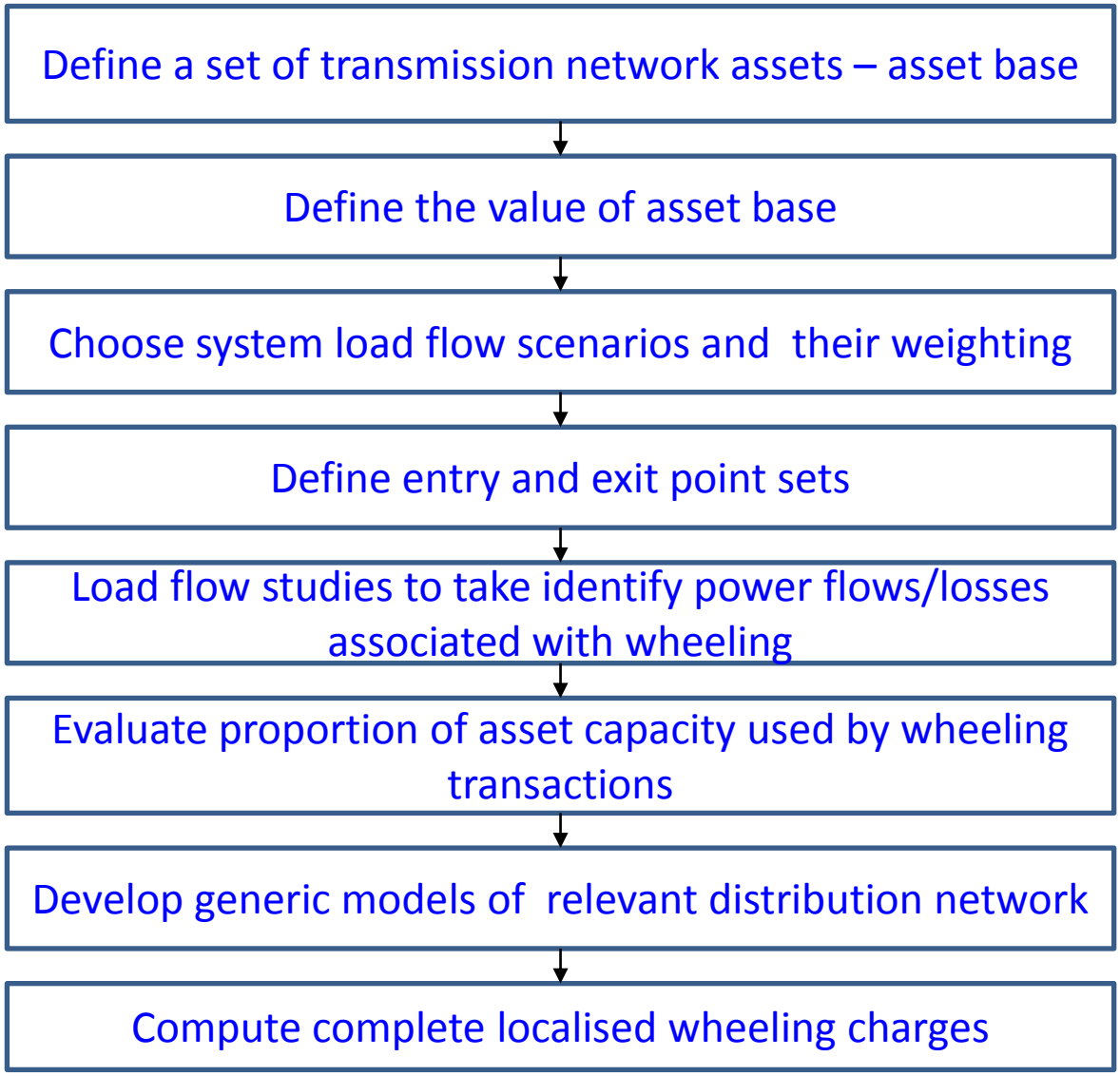
Key findings

- The proposed methodology is compatible with the high level objectives of the OUR Act
  - particularly promotion of competition in generation
- JPS All-Island Electric Licence requires non-discrimination in connection/use of system
  - a clear and transparent wheeling charge structure will assist this
- JPS Licence also requires wheeling charges to be developed that are:
  - cost reflective
  - consistent with tariffs (and must therefore avoid under/over-recovery
  - guided by a Cost of Service study
- Need to confirm that locational variation of charges is permissible

Key implementation issues

- Distinction between connection and use of system charges – where are the boundaries?
- Incorporate appropriate depreciation rates into treatment of assets
- Share of costs between generators and consumers?
- Agree approach to network constraints
- Adjustment of charges to ensure full revenue recovery
- Confirm that reserves etc. (covered by Q-factor) are outside the scope of the wheeling charges
- Metering, top-up and standby pricing arrangements

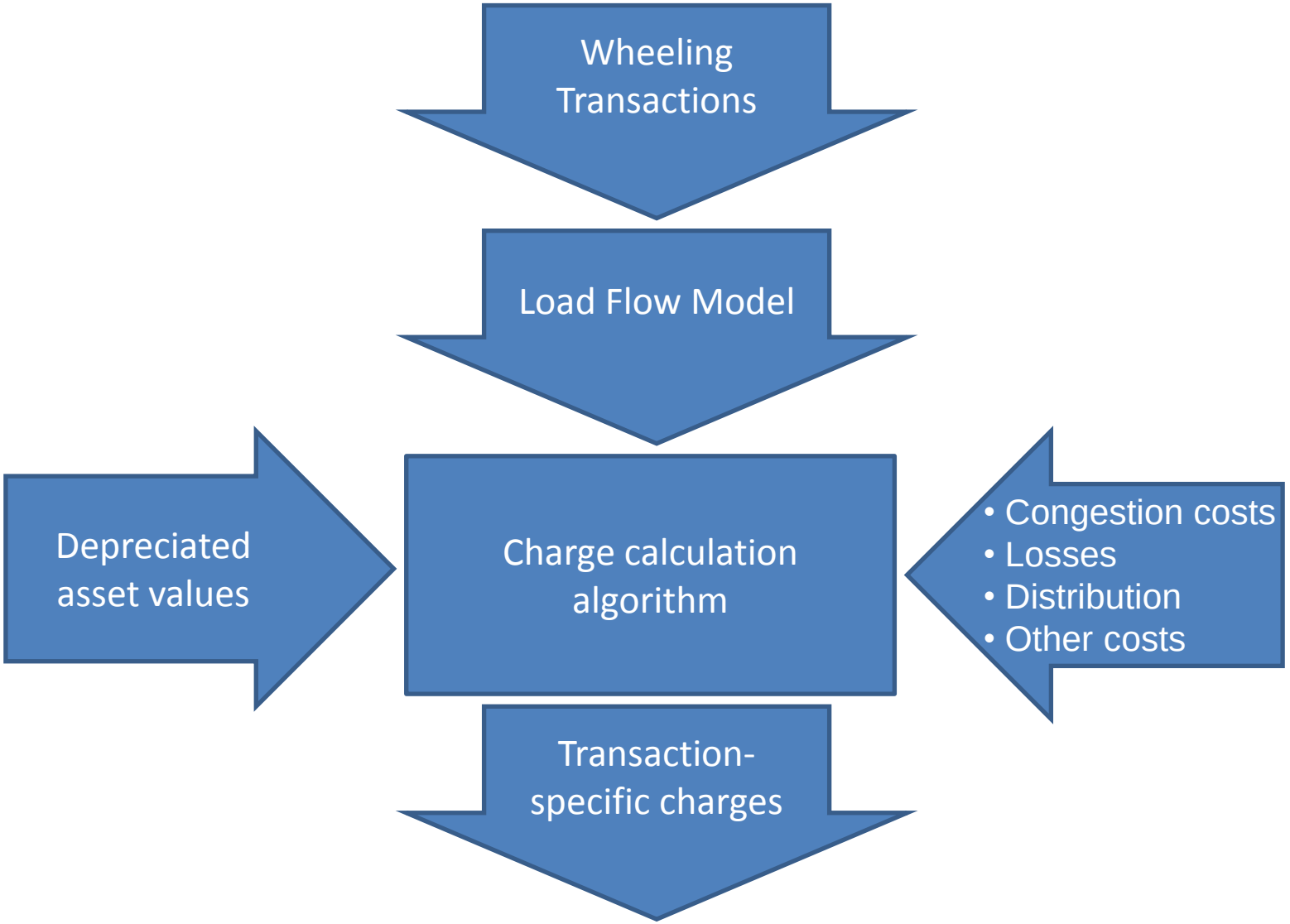
MW-km Methodology implementation Flow diagram



Specific steps

1. Define transmission network assets to be included in wheeling methodology
2. Define asset values – obtain JPS asset register, carry out cost of service assessment
3. Agree load flow scenarios: mix of peak, off peak and shoulder scenarios
4. Define entry and exit points for wheeling based on current transactions
5. Run load flow studies to account for power flows and losses at transmission level
6. Apply asset costs in proportion to wheeling power flows – ratings?
7. Derive net transmission wheeling costs (1)
8. Develop distribution network generic model that is part of the wheeling
9. Add the cost of distribution wheeling costs (2) to transmission costs (1)
10. Calculate final locational wheeling charges as costs per MW or costs per MWh.

Wheeling model components



Next Steps

- Consultants visit/Training seminar – 3 December
- OUR agreement on wheeling charge methodology
- JPS to supply load flow studies information in several iterations as required
- Consultation on proposed charging methodology
- PPA Energy will develop detailed spreadsheet model
- PPA Energy to develop distribution cost model
- PPA Energy to complete cost of service component, to sufficiently differentiate between wheeling costs and network costs
- PPA Energy to complete and submit a final wheeling charge model to the OUR
- PPA Energy to draft outline content for regulations for wheeling charge implementation
- Training seminar- Final wheeling charge model
- Project Completion

Project programme – next steps

Schedule of Activities		Week Commencing																
Jamaica Wheeling Charges including cost of service study		22-Oct 1	29-Oct 2	05-Nov 3	12-Nov 4	19-Nov 5	26-Nov 6	03-Dec 7	10-Dec 8	17-Dec 9	24-Dec 10	31-Dec 11	07-Jan 12	14-Jan 13	21-Jan 14	28-Jan 15	04-Feb 16	11-Feb 17
5	**Cost of Service Study**																	
5.1	Develop cost of service spreadsheet																	
5.2	Provide cost input to wheeling model																	
6	**Develop Wheeling Charge Model**																	
6.1	High level data review																	
6.2	Develop wheeling model																	
6.3	Populate and test model																	
6.4	Prepare User Manual																	
7	**Develop regulatory framework**																	
7.1	Develop regulatory framework																	
8	**Draft Report**																	
8.1	Prepare draft final report including cost of service study																	
9	**Training Session #2**																	
9.1	Prepare training session #2																	
9.2	Deliver training session on wheeling model and reg. framework																	
9.3	OUR feedback / approval of draft final report and model																	
10	**Final Report**																	
10.1	Prepare final report including cost of service study																	
	Deliverables																	
	Inception report																	
	Methodological report																	
	Training Session #1 - Wheeling methodology																	
	Tariff wheeling model and instruction material																	
	Draft final report including cost of service study																	
	Training Session #2 - Wheeling model and regulatory framework																	
	Final report (to include cost of service study)																	

Questions and discussion

Impact on charging methodology

Thank you!

Our Contacts

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