From: Jim Hindson <jhindson@telus.net>
Sent: Tuesday, April 10, 2018 9:11 PM
To: Commission Secretary BCUC:EX
Cc: Lisa Locke; James Locke
Subject: Victoria Public Session - Lisa Locke
Attachments: DCFC Business Case Issues.pdf

I was advised by Lisa that the panel members expressed an interest in knowing more about
The VEVC Business Case models for Electric Vehicle Charging Services (EVCS)

Attached please find a short PowerPoint that outlines the Business Case Models in response to the inquiry at the Victoria event and that form the basis of our findings based on the information available to date.

These are updated versions (with improved costing information) of the models included in Appendix E of the original VEVC submission

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VICTORIA EV CLUB

Victoria Electric Vehicle Association

dba The Victoria Electric Vehicle Club VEVC

Business Case Issues with EV Charging Services (EVCS)

April 10, 2018

EVCS Business Case Issues

This presentation is a supplement to the information provided in Appendices A, B, & E of the VEVC Submission to the BCUC dated April 4, 2018.

The information included in this presentation is based on additional information available to the authors as of April 10, 2018.

If additional relevant precise information is available on the topics included please share it with us in order that the models presented can be updated.

If any issues or concerns arise regarding the analysis, assumptions or data sources please advise us. The only purpose of this document is to further the discussion and resolution of issues concerning the financial sustainability of DCFC units and cost-recovery systems.

Contact: info@VictoriaEVclub.com

EVCS Business Case Issues

Presentation Overview:

- The Business Model for Electric Vehicle Charging Services (EVCS)
  - The Time-Based model (per minute)
  - The Consumption-based model (per kWh)
- The Business Case for EVCS based on:
  - 50 kW fast Chargers
  - Session length (charge received per connected session)
- Business Case Risks
- Improving the Business Case

EVCS Business Case Issues

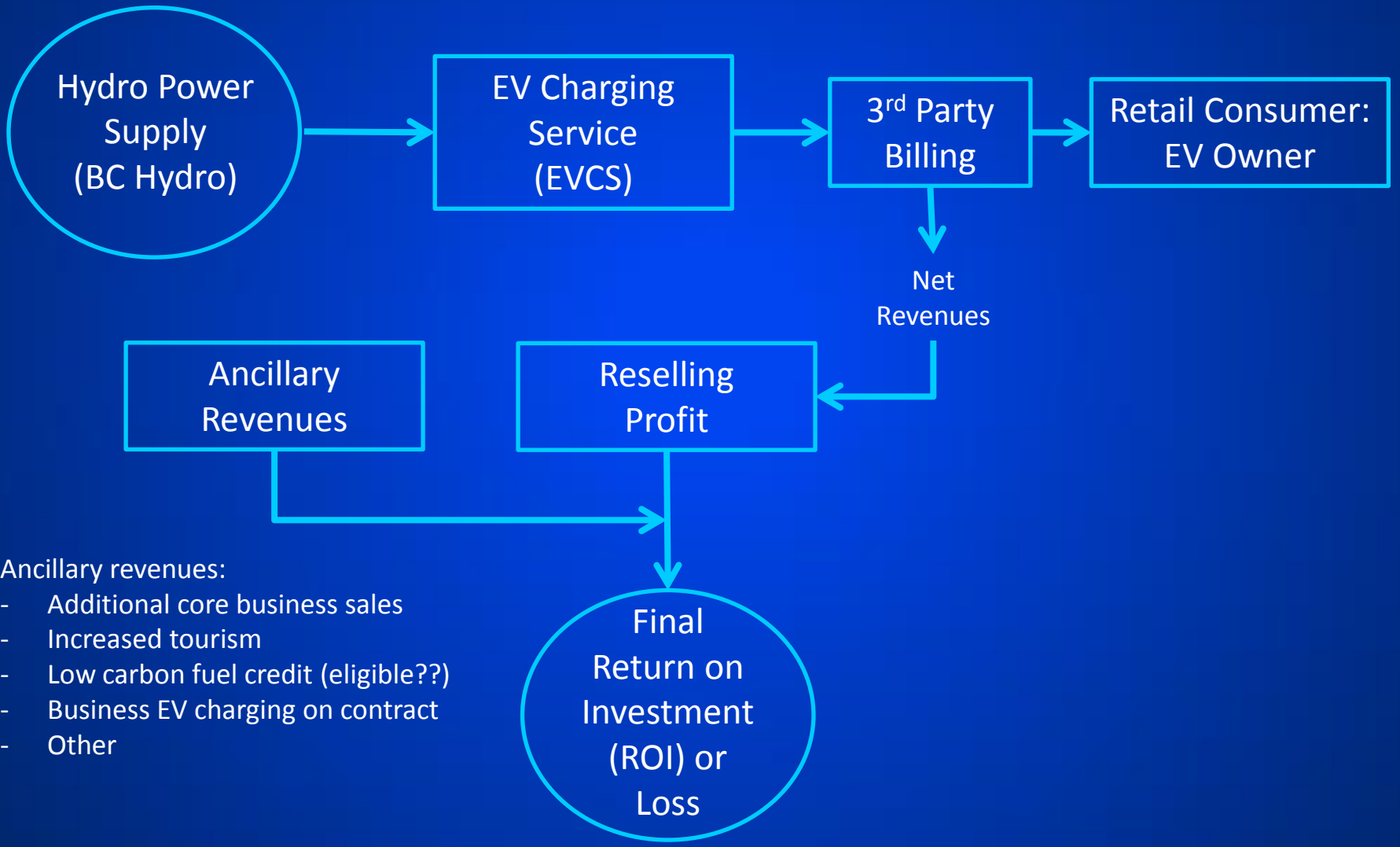
The Basics of the EVCS Business Model

- DCFCs are expensive
- Including land or real estate is not affordable as a DCFC cost
- The EVCS market is in its early stages – growth will depend on EV sales growth
- Highest potential return is in areas of highest demand for fast charging
- Higher financial risks are associated with more remote areas with low EV traffic and higher maintenance costs

EVCS – Electric Vehicle Charging Services

EVCS Business Case Issues

The Basics of the EVCS Business Model



Ancillary revenues:

- Additional core business sales
- Increased tourism
- Low carbon fuel credit (eligible??)
- Business EV charging on contract
- Other

EVCS Business Case Issues

The Time-Based EVSC Business Case

- A “time-based” business case would be based on reselling electricity based on how long the EV occupies the charging space and levying a “charging fee” based on how long the EV occupies the space.

- Occupancy time, hence charging “fees” could be measured by:
  - connected time to the charging unit (via 3rd party billing system)
  - space occupancy via a parking meter or similar record of space occupancy only

EVCS Business Case Issues

The Time-Based EVSC Business Case

Charging a time-based fee if selected on the basis of a “perfect” Gen 1 EV would result in overcharging in many cases due to:

- vehicle charging speed variances
- weather conditions
- battery state of charge
- battery temperature
- battery thermal management
- battery conditioning

The result is that there could be moderate to severe overcharging for value (kWh) received

DCFC (Level 3) Charging
Fee Comparisson of hourly vs kWh
Based on 30 kWh charge 50 kW DCFC

		EV DCFC Rate		
	Cost	50 kW	100 kW	150 kW
Fee per hour	$ 10.00	$6.00	$3.00	$2.00
	$ 17.50	$10.50	$5.25	$3.50
	$ 35.00	$21.00	$10.50	$7.00
Fee per kWh	$ 0.25	$7.50	$7.50	$7.50
	$ 0.35	$10.50	$10.50	$10.50
	$ 0.50	$15.00	$15.00	$15.00

	Hour	vs	Rate			
Difference Fees	$10.00	vs	$0.25	($1.50)	($4.50)	($5.50)
	$17.50	vs	$0.35	$0.00	($5.25)	($7.00)
	$35.00	vs	$0.50	$6.00	($4.50)	($8.00)

Percent Overcharged (Undercharged)

	Hour	vs	Rate			
Difference Percent	$10.00	vs	$ 0.25	(25)%	(150)%	(275)%
	$17.50	vs	$ 0.35	0%	(100)%	(200)%
	$35.00	vs	$ 0.50	29%	(43)%	(114)%

Example 1
to recover the the cost of 0.35 cent electricity at a 50 kW DCFC would require a time-based fee of $17.50 /hour
However EVs charging at lower rates due to a number of conditions woud be overcharged

EVCS Business Case Issues

The Time-Based EVSC Business Case

Charging a time-based fee at a new 100kW DCFC based on a Gen 2 EV would result in overcharging in most cases due to:

- All the conditions in the previous slide plus:

- any Gen 1 vehicle could be significantly overcharged with “actual“ rates reaching $1.45/kWh or more.

The result would be expected to be significant public complaints about overcharging

DCFC (Level 3) Charging
Fee Comparisson of hourly vs kWh
Based on 30 kWh charge 100 kW DCFC

		EV DCFC Rate		
	Cost	50 kW	100 kW	150 kW
Fee per hour	$10.00	$ 6.00	$3.00	$2.00
	$17.50	$ 10.50	$5.25	$3.50
	$35.00	$ 21.00	$10.50	$7.00
Fee per kWh	$ 0.25	$ 7.50	$7.50	$7.50
	$ 0.35	$ 10.50	$10.50	$10.50
	$ 0.35	$ 10.50	$10.50	$10.50

	Hour		vs	Rate		
Difference Fees	$ 10.00	vs	$ 0.25	($1.50)	($4.50)	($5.50)
	$ 17.50	vs	$ 0.35	$0.00	($5.25)	($7.00)
	$ 35.00	vs	$ 0.35	$10.50	$0.00	($3.50)

Percent Overcharged (Undercharged)

	Hour		vs	Rate		
Difference Percent	$ 10.00	vs	$ 0.25	(25)%	(150)%	(275)%
	$ 17.50	vs	$ 0.35	0%	(100)%	(200)%
	$ 35.00	vs	$ 0.35	50%	0%	(50)%

Example 2

to recover the the cost of 0.35 cent electricity at a 100 kW DCFC would require a time-based fee of $35.00 /hour (Hyundai Ioniq)
Slower 50 kW or less EVs would be significantly overcharged by $17.50 per hour or more
Equivalent charges of $1.45/kWh would be commonplace

EVCS Business Case Issues

The Time-Based EVSC Business Case

Observations:

- There is no basis to reliably predict revenue from time-based fees as the mix of vehicle makes and models, charging conditions and impacts on revenue is unknowable and would constantly shift over time.
- The complaints received about overcharging could not be mitigated and would ultimately be expected to affect business reputation and revenues

Business Risks

- High “actual” rates and unexplained fees could affect sales
- A higher degree of uncertainty about cost recovery

Conclusion

Time-based fees for EV Charging Services are unsustainable and have no measureable business case

EVCS Business Case Issues

The Consumption- Based EVSC Business Case

- A consumption-based Business Case is reselling electricity based on the number of kWh delivered to the vehicle and includes kWh consumed to heat or precondition the battery or any other losses from the charger to the main battery pack.
- Consumption could be measured by the DCFC reporting on kWhs dispensed by the DCFC unit to a 3rd party charging system
- Additional fees could be applied by the minute for EVs continuing to occupy the EV space while no longer charging

The Consumption - Based EVSC Business Case – Scenario 1

In Scenario 1 presented to the right, a revenue of $33,510 would be required to offset capital costs and a further revenue of 15 cents per kWh would be required to offset the variable costs of an amortized DCFC installation.

At 3,000 15 kWh sessions per year the required fee would be ~ 80 cents/ kWh which would be higher than the (psychological barrier) of the equivalent gasoline cost of 68 cents/ kWh
(Refer to the next slide)

Costs do not currently include background load or heating costs

DCFC Costs included in the Financial Model

Scenario 1) Fixed Costs to be offset for 6% ROI

Assumptions:

Includes initial cost of a DCFC unit and Installation ($100K)
No return of capital ($100K - $50K DCFC and $50K installation)
Annual Provision of $10K for replacement of charger ($50K) over 5 years
No adjustment for Net Present Worth of replacment

Statement of Revenue and Expenses for 6% ROI

	6% Return	
Revenue		
Charging Revenue (to overcome fixed costs only)	$ 33,510	
Expenses		
Annual Networking Cost for Billing System	260	
Annual Maintenance Cost	6,000	
Annual Electricity Demand Charges	3,500	
Capital Acquisistion 100,000/10	10,000	
	19,760	
Net Income Before Income Taxes	13,750	
Income Taxes (20%)	2,750	
Net Income After Taxes (6% ROI + Replacement)	$ 11,000	per year

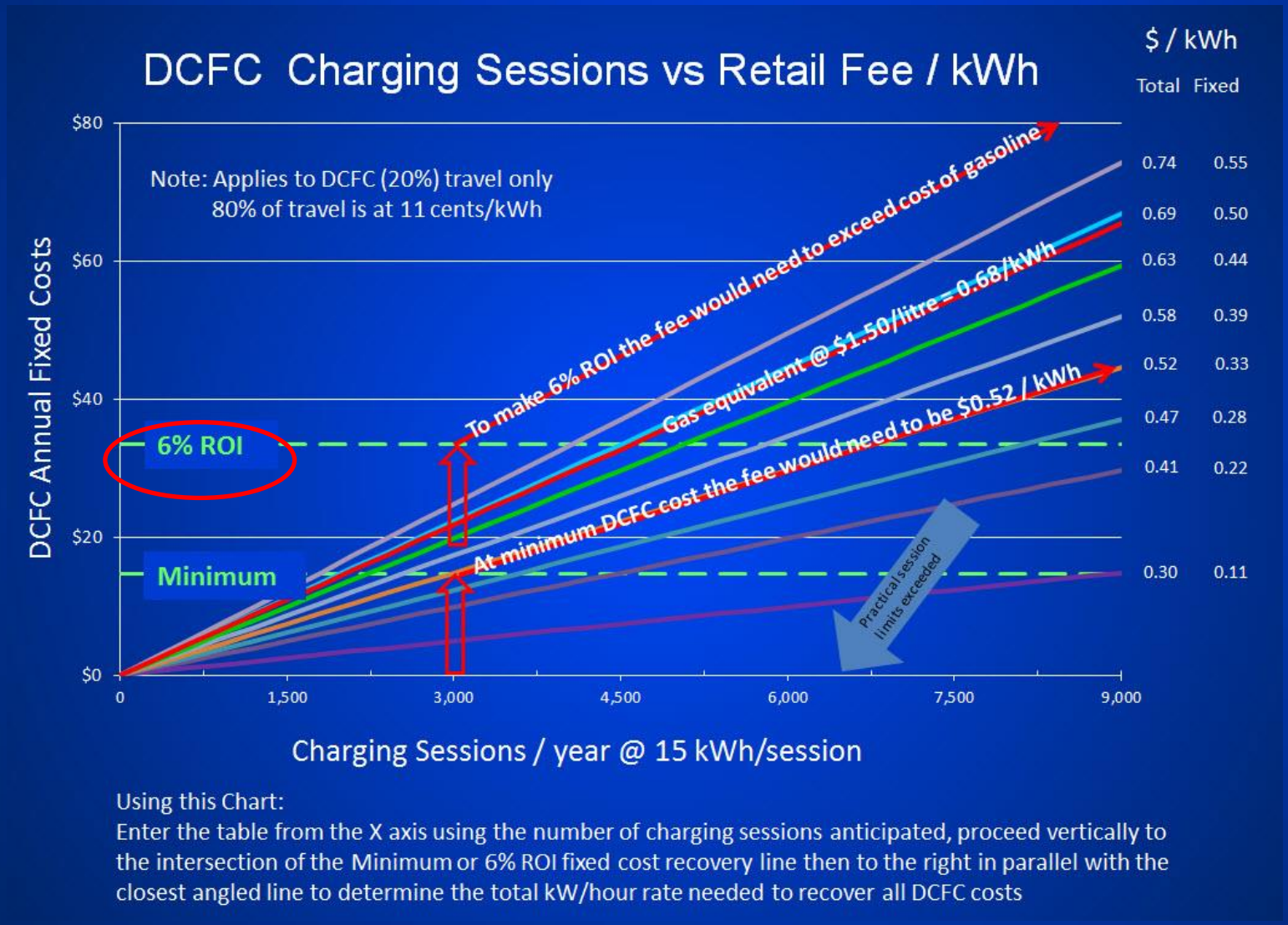
$ 11,000 Net income includes $6,000 ROI and $5,000 Reserve for replacement

Scenario 1) Variable costs to be offset (all)

Cost of electricity	0.11	per kWh
Cable Replacement Cost ($3K per 2,500 sessions)		
2,500 Sessions $ 3,000 75,000 kWh	0.04	per kWh
Total Variable Cost	$ 0.15	per kWh

The Consumption - Based EVSC Business Case – Scenario 1

- A 50 kW DCFC with 3,000 15 kWh charging sessions per year has no 6 % ROI business case below the equivalent cost of gasoline as the fee would need to be > 80 cents/kWh



The Consumption - Based EVSC Business Case – Scenario 2

In Scenario 2 presented to the right, a revenue of $14,760 would be required to offset capital costs and a further revenue of 15 cents per kWh would be required to offset the variable costs

At 3,000 15 kWh sessions per year the required fee would be 52 cents/ kWh
(Refer to the next slide)

Costs do not currently include background load or heating costs

Scenario 2) Fixed Costs to be offset for minimum Costl

Assumptions:

Grant or 100% subsidy for Initial cost of DCFC unit and Installation ($100K)
Municipal installation - no income taxes
Annual Provision of $10K for replacement of charger ($50K) over 5 years
No adjustment for Net Present Worth of replacment

Statement of Revenue and Expenses for minimum costs

	0% Return	
Revenue		
Charging Revenue (to overcome fixed costs only)	$ 14,760	
Expenses		
Annual Networking Cost for Billing System	260	
Annual Maintenance Cost	6,000	
Annual Electricity Demand Charges	3,500	
Initial Unit Cost (installed)	-	
	9,760	
Net Income Before Income Taxes	5,000	
Income Taxes - not applicable	-	
Net Income After Taxes	$ 5,000	per year

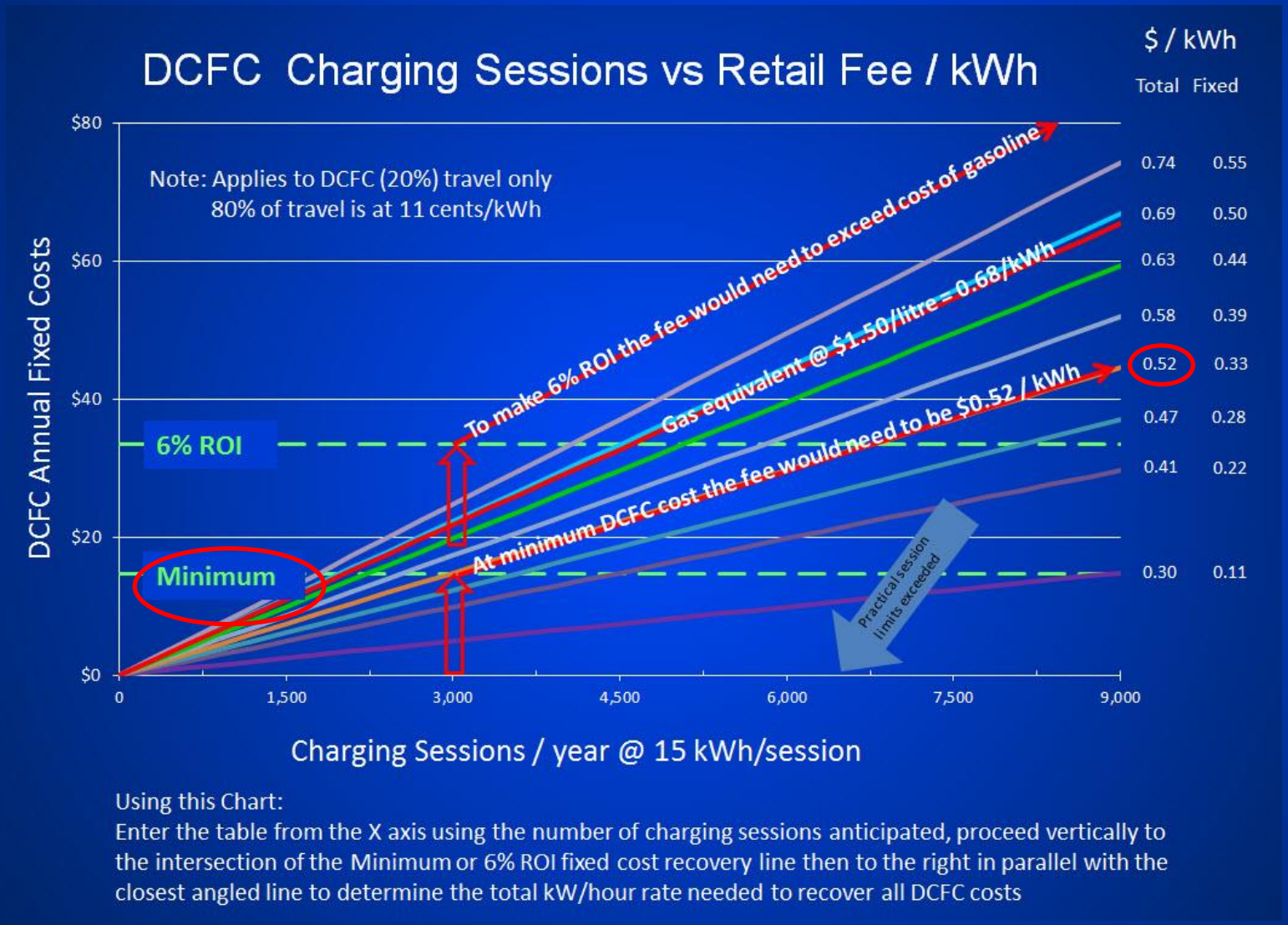
$ 5,000 Net income includes $5,000 Reserve for replacement

Scenario 2) Variable costs to be offset (all)

Cost of electricity	0.11	per kWh
Cable Replacement Cost ($3K per 2,500 sessions)	-	-
2,500 Sessions 3,000 75,000 kWh	0.04	per kWh
Total Variable Cost	$ 0.15	per kWh

The Consumption - Based EVSC Business Case – Scenario 2

- A 50 kW DCFC with 3,000 15 kWh charging sessions per year has a minimum business case below the equivalent cost of gasoline with fee at ~ 52 cents/kWh



EVCS Business Case Issues

The Consumption-Based EVSC Business Case

Observations:

- Estimated charging sessions per year could form the basis for determining anticipated revenues.
- There would be few expected complaints about overcharging as fees are based on dispensed kwh and (somewhat) verifiable by monitoring the vehicle's main battery state of charge (SOC).

Business Risks

- There is no business case under current cost/volume conditions without initial capital subsidy or incentives and/or ancillary sources of revenue
- Associated with the ability to accurately estimate session volumes
- May depend on the ability to develop ancillary revenues to offset DCFC costs
- Technology change that could reduce capital costs for competitors

Conclusions

- Consumption-based EV Charging Services are sustainable under some circumstances
- Public- sector EVCS could require external funding sources for initial unit

EVCS Business Case Issues

Improving the Business Case

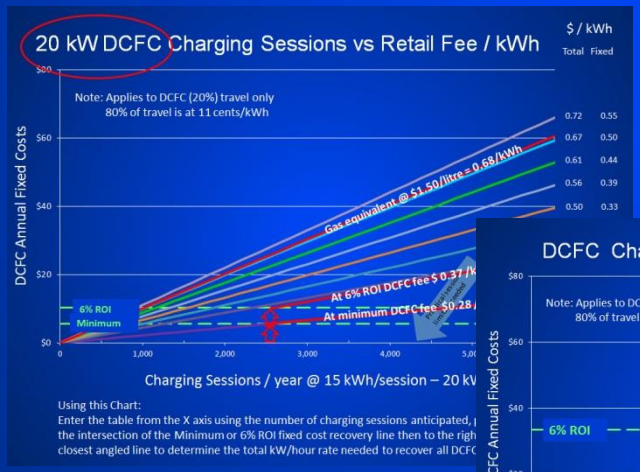
The EVCS Business Case could be improved through:

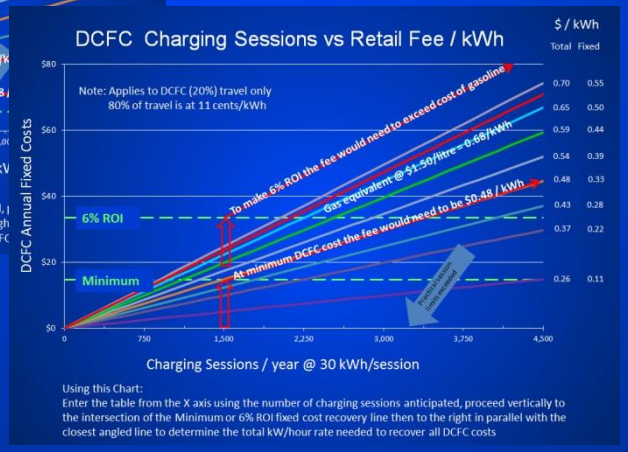
- Lowering DCFC unit costs through volume and competition
- Developing a lower-cost DCFC multi station architecture to separate dispensers from the power units.
- The using of prefabricated DCFC bases
- Reducing DCFC maintenance costs
- Reducing the high maintenance costs caused by damage to the CHAdeMO and CCS receptacles.
- Increasing revenue from ancillary sources
- Qualifying for low carbon fuel credits
- Higher powered DCFC units (100 kW) – more charging sessions per hour
- Lower demand charges (possibly by using station batteries or other power management technologies

EVCS Business Case Scenarios

Alternative Business Case scenarios can be produced for:

- different wholesale electricity rates
- alternative DCFC sizes (20 kW, 100kW, 150 kW)
- higher average charging session amounts (30 kWh – Second generation EVs)
- improved pricing information
- improved cost for equipment, installation, & maintenance





EVCS Business Case Issues

End