



@EVSymposium29
#EVS29

Electric Vehicle Symposium & Exhibition

June 19-22, 2016 | du 19 au 22 juin 2016

Montréal, Québec, Canada

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DRIVE ELECTRIC INNOVATION
PROPULSER L'INNOVATION EN MOBILITÉ ÉLECTRIQUE

EVS29.ORG



HYDRO-QUEBEC's V2G-V2H Project

Jean-Luc DUPRÉ, Transportation Electrification Department,
Hydro-Québec



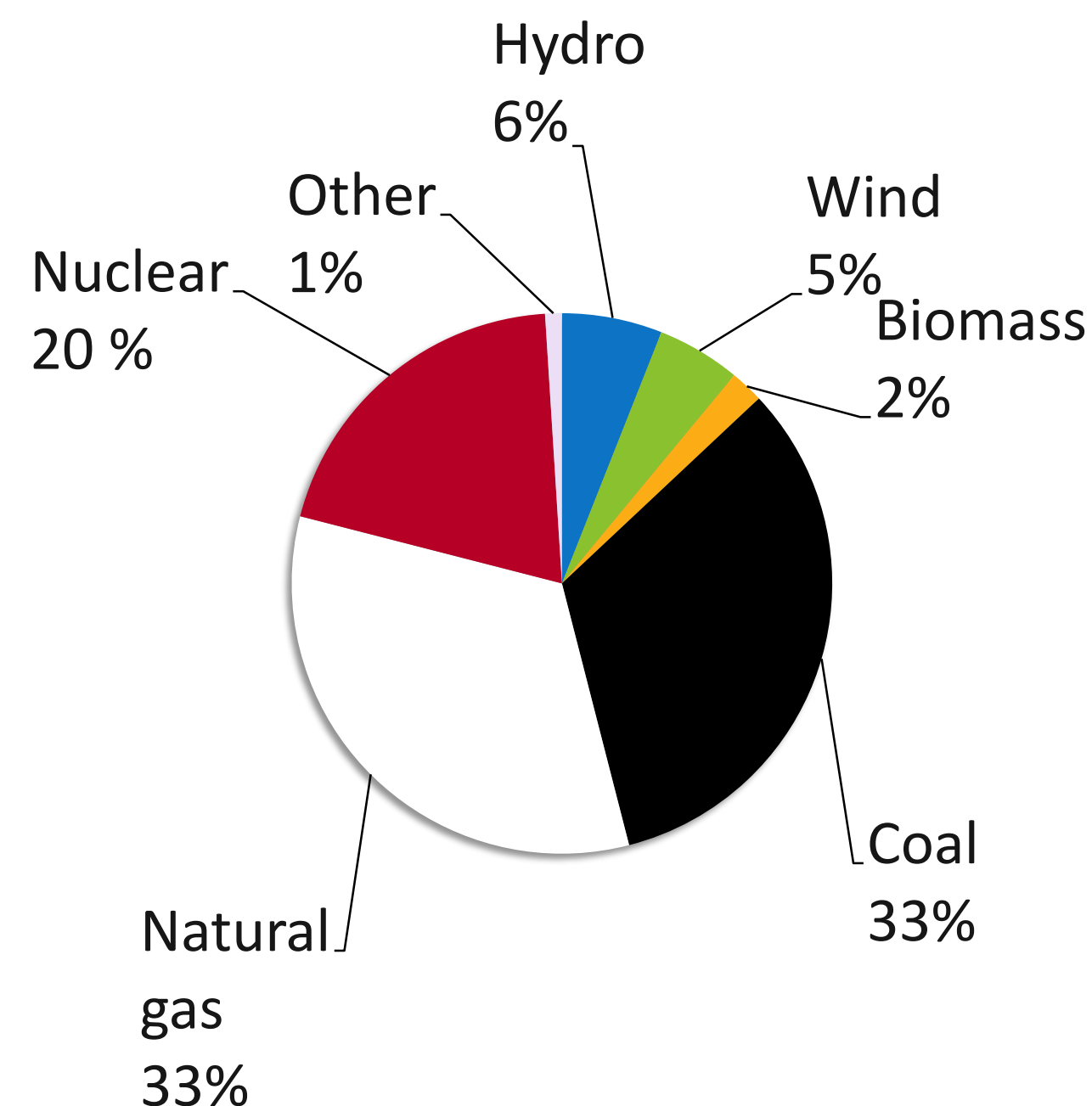


HYDRO-QUÉBEC CONTEXT

MEANS OF ELECTRICITY GENERATION

United States 2015^(a)

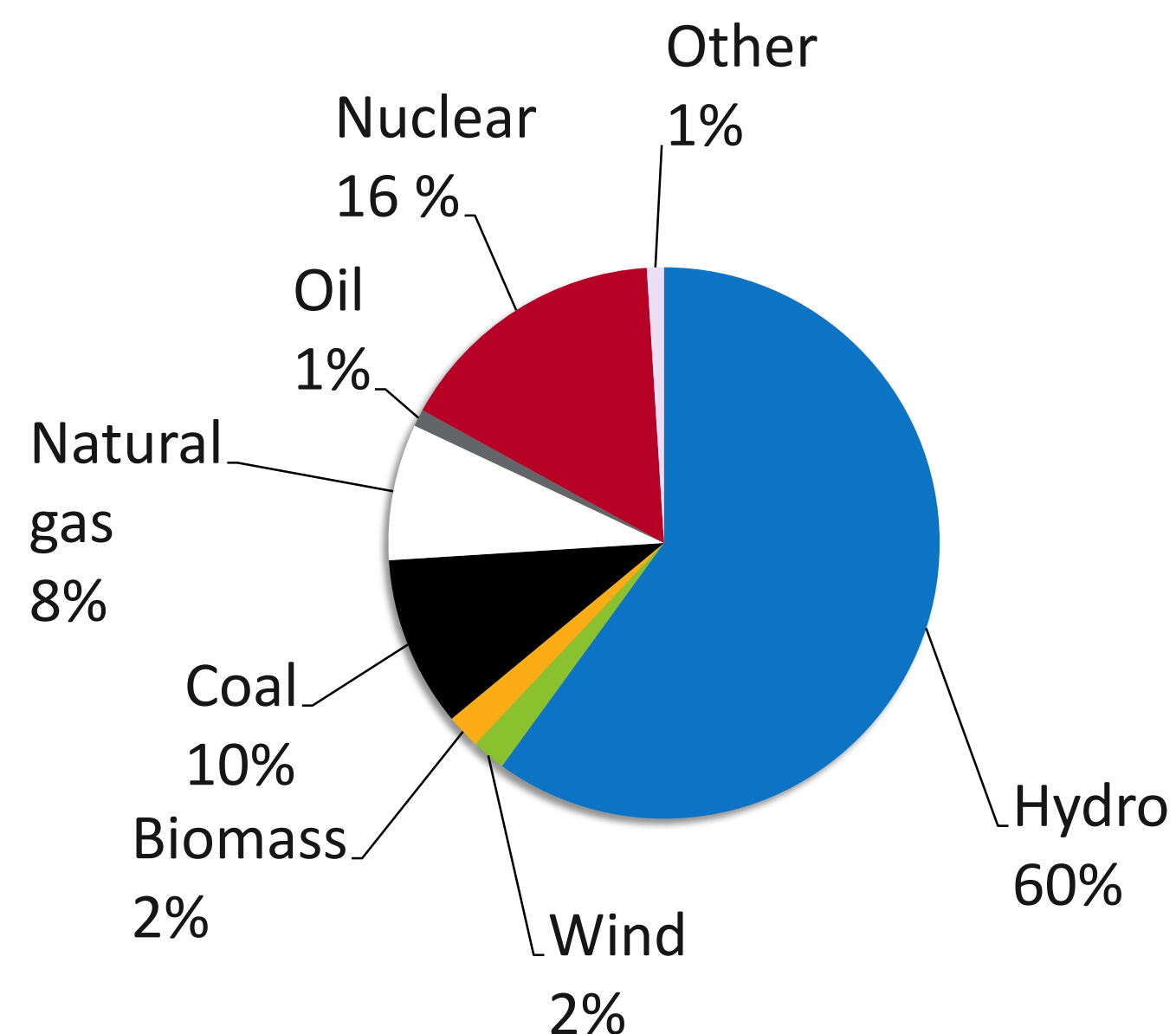
Electricity generation: 4,090 TWh



Clean energy = 13%

Canada 2014^(b)

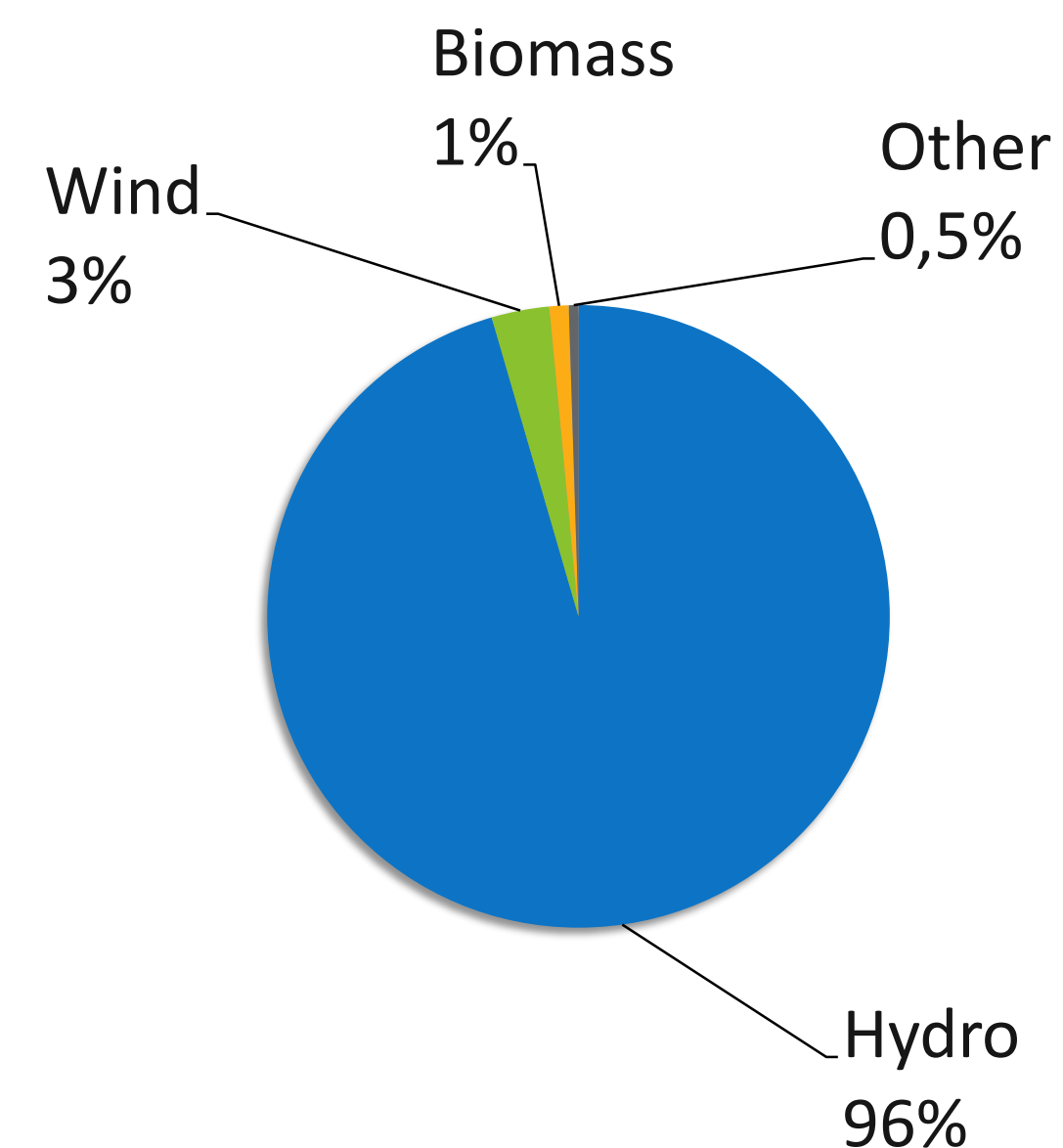
Electricity generation: 630 TWh



Clean energy = 64%

Québec 2014^(b and c)

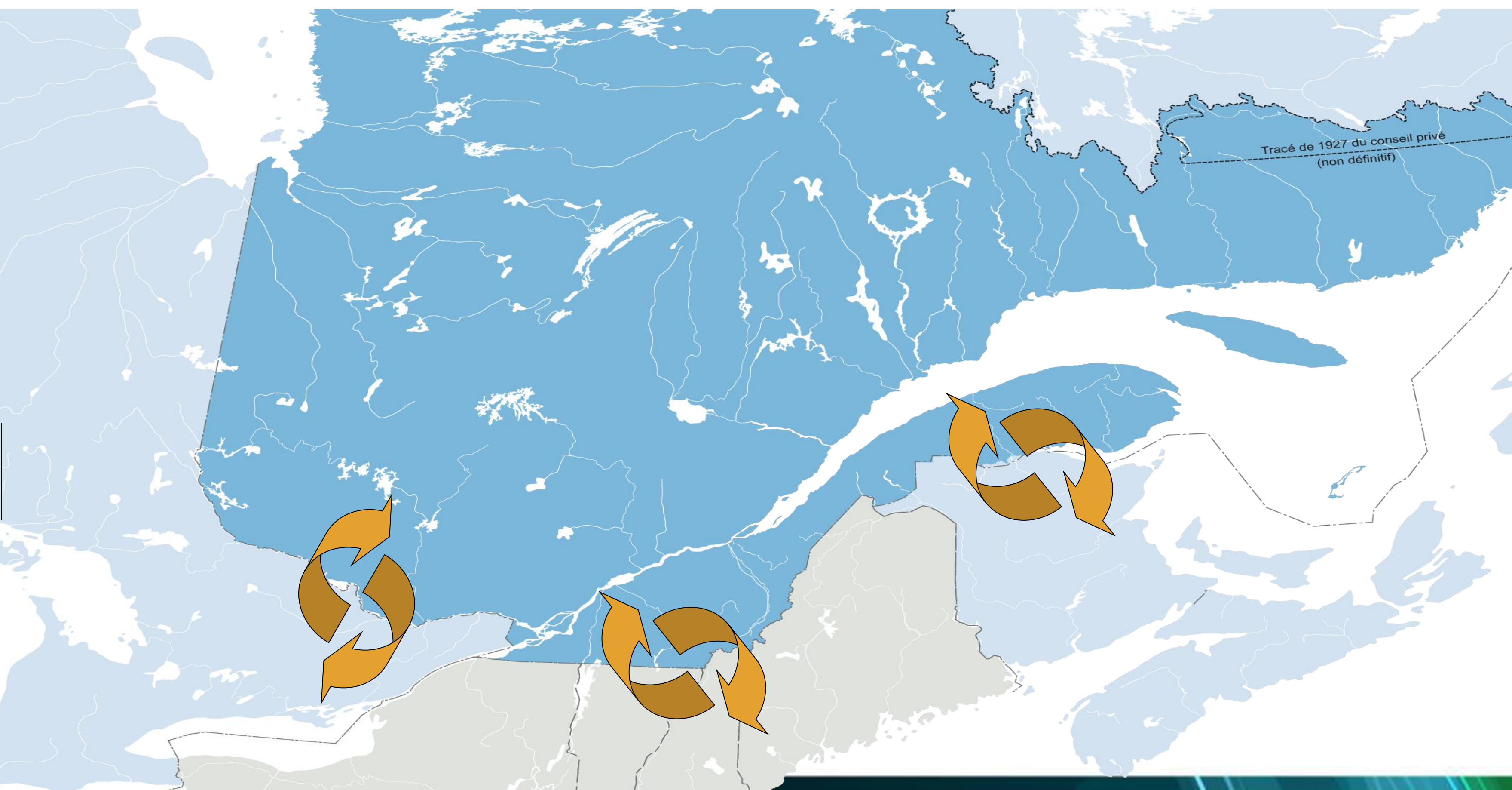
Electricity generation: 205 TWh



Clean energy > 99%

Sources : (a) Energy Information Administration, 2016 – (b) Statistics Canada, 2015 – (c) Hydro-Québec, 2015

- Peak power demand period in Québec = winter (for heating needs)
- Peak power demand period in neighbouring markets = summer (for A/C)



Electricity sales

	2015
<i>In Québec</i>	
TWh	171.3
<i>Outside Québec*</i>	
TWh	29.9

** American markets,
Maritimes and Ontario



A THREAT?: IMPACT OF 1 MILLION OF EV's ON GRID

Energy demand

3,6 TWh per year (about 2% of increase)

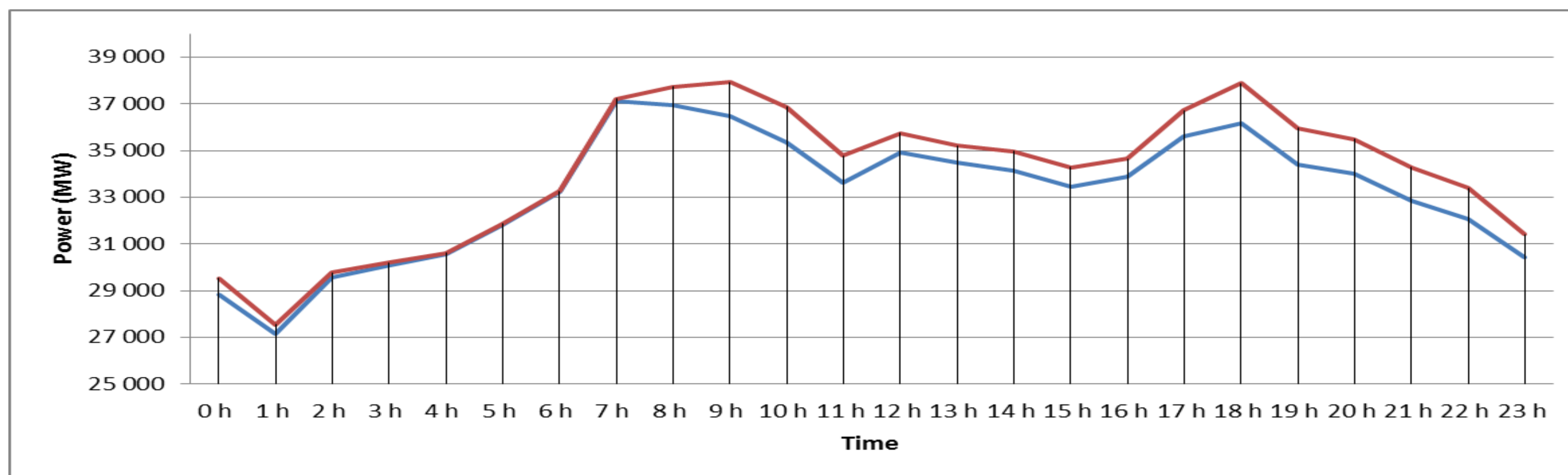
Less than the increase of consumption between 2012 and 2013



Impact on the peak power demand (winter)

Increase of about 1100 MW (more than 1,1 kW/car, about 3% of increase))

Power Shortage already expected (about 1500 MW) in 2019-2020 without EV car demand



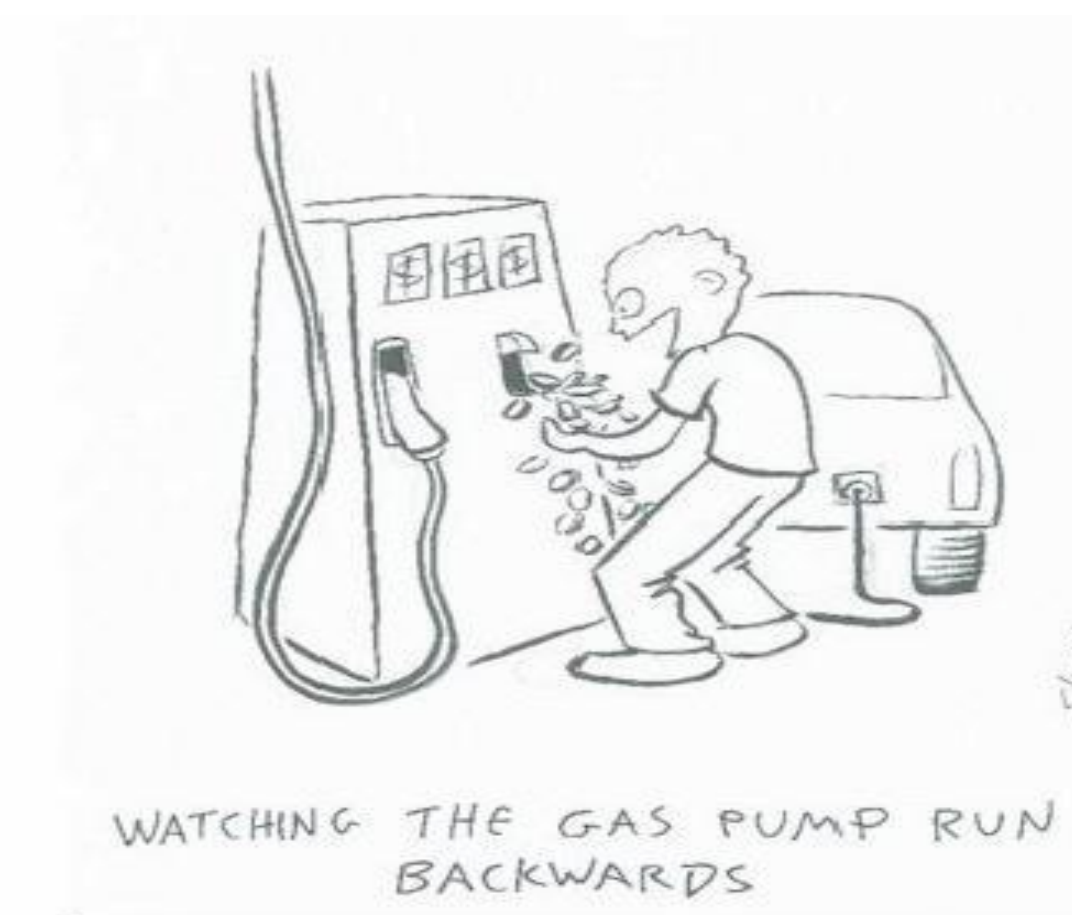
Experiment with using energy stored in battery when vehicle is parked at home

Modulation of the charging power : Demand response-V1G

Supply part of home (Building) in case of power failure or to perform load shedding :V2H (V2B)

Supply power grid (V2G)

EV cars may become an opportunity and not a threat for the grid





ELECTRIC VEHICLES

Power Exchange with the Home and the Grid



**EVs could
serve as
“green”
generators**

Main Trial objectives

Verify feasibility

Knowledge on user's behaviors and satisfaction

Determine services that could be provided

Trial details

One-year trial period

Completed in early 2015



SYSTEM'S BASIC PRINCIPLES



MAIN RESULTS

- proven

Feasibility



- ≤ 2
seconds

Response
time



- $\leq 2\%$

Demands
denied



- About
30%

Losses



- Very High

User's
satisfaction



- V2G/V2H
duration

Information
required



- None

Inconvenience



- 15 km
+ distance of
next travel

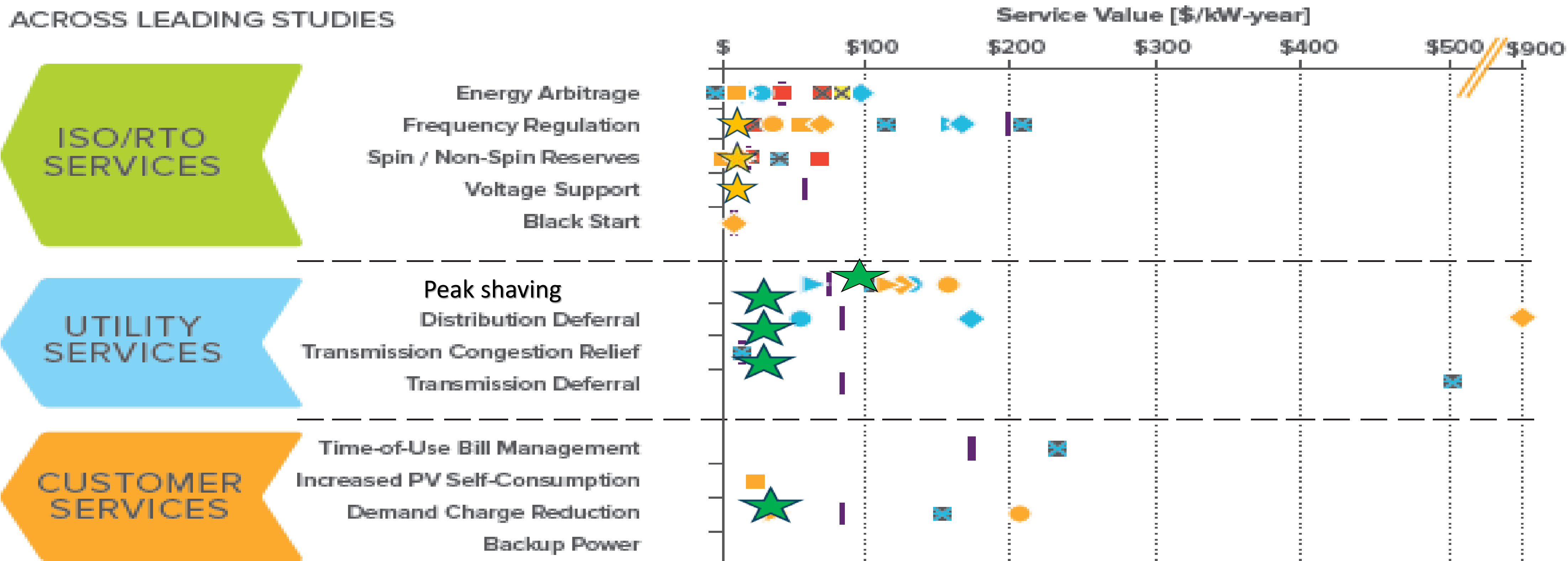
Minimum
range



SERVICE VALUE : VARIES ACROSS COUNTRIES AND UTILITIES

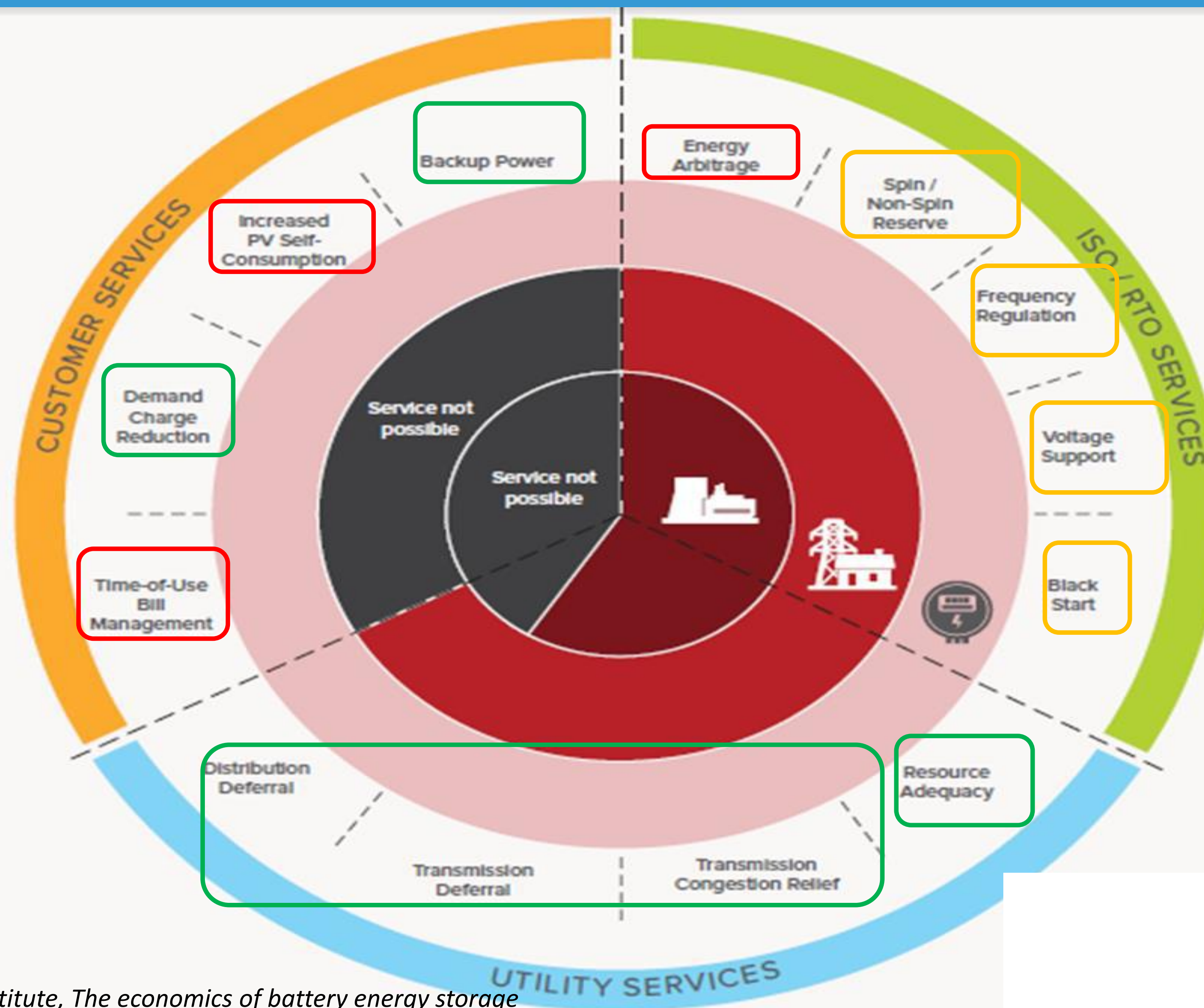
FIGURE 3

ENERGY STORAGE VALUES VARY DRAMATICALLY
ACROSS LEADING STUDIES



Source: Rocky Mountain Institute, *The economics of battery energy storage*

POTENTIAL SERVICES PROVIDED BY BATTERIES



Not yet relevant in
Quebec's Context

Suitable

Best match

V2G DURING PEAK HOURS (WEEK DAYS)

Morning (6h30 to 10h00)

Batteries are full

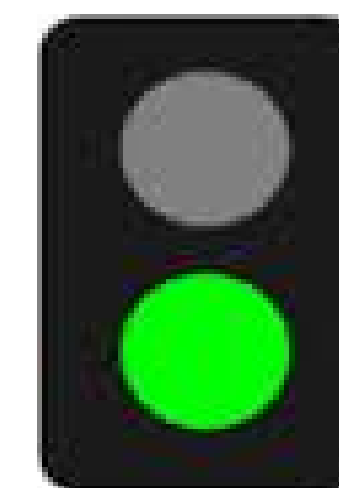
V2G performed if the vehicle is connected

Afternoon (16h30 to 19h00)

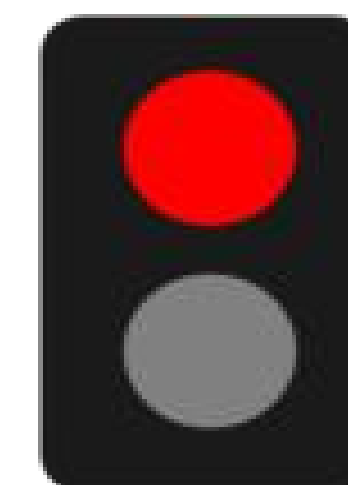
Batteries are no longer full due to the journey

V2G is performed :

- when the vehicle is at home
- till the minimum SOC is reached



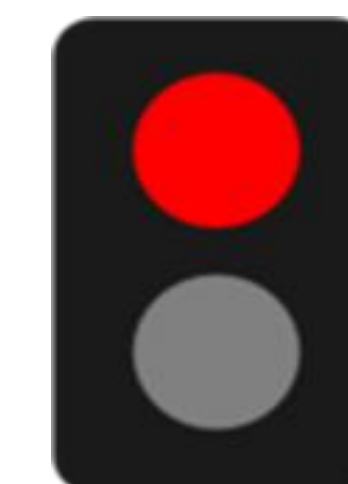
Before 7h45



After 7h45



Around 17h and
25% not possible



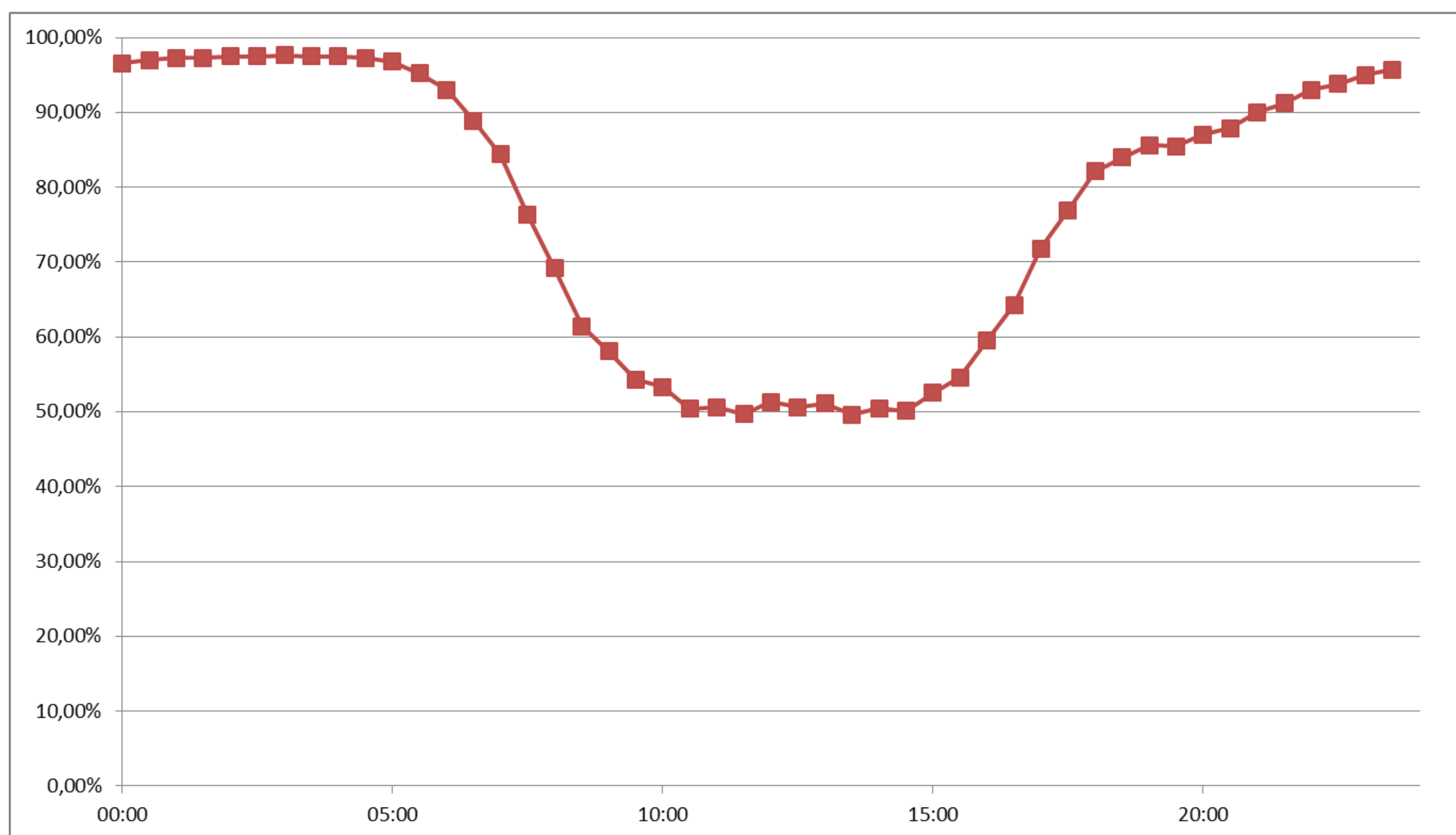
After 30 minutes

Pilot Project

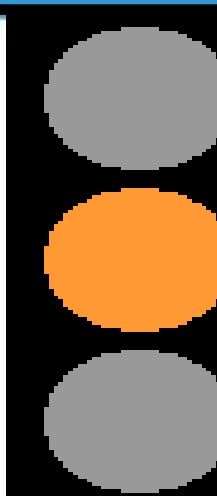
V2G DURING PEAK HOURS (WEEK DAYS)

90% of drivers drive less than 60 km per day for commuting

More than 50% of cars are parked at home during peak hours



Source: MTQ. Enquête origine-destination 2008 AMT



About 50% of the vehicles power during the 6 peak hours
100.000 EV= 200 MW

This value depends on many factors!



EV with 48 kWh battery

Electric vehicles parameters

Number of Electric Vehicles with V2G fonctionnaility

Battery capacities

Power level of the charger (onboard or off-board) or the EVSE connection, whichever is weaker.

Type of VE: PHEV or BEV

Customers behaviors

Departure and arrival times at home

Minimal SOC (State of charge) of the battery

Others parameters

Efficiency (losses) of the different components

Charge at work

Better knowledge of all of these parameters are required but « BEST MATCH » FOR V2G in QUEBEC

The charging and discharging of a battery can be adjusted quickly and accurately (1 to 2 s is achievable) making EVs able to regulate frequency

Current Regulation and spinning reserves

In HQ, regulation services are provided by hydro resources

No regulation market in Quebec

Regulation clearing prices much more lower than US price

Efficient frequency regulation required because HQ Network inertia is low (few interconnections)

« May be used » in QUEBEC

Limited numbers of Evs and No off the shelf products for V2G

Capital cost for technology:

additionnal equipment to avoid unsafe electricity injection to the grid,
hardware and house connection.

Inconsistent data communication approaches among Utilities and PEVs

Aggregators required

Efficiency losses of the different equipment

Battery degradation (over-emphasized concern?)

Values of benefits as well as the costs are largely unknown,

Peak shaving aspect of V2B (Vehicule to Building) will help :

Building owners to reduce the electricity cost by reducing the Power Cost

To reduce the peak of Hydro-Quebec during the winter without any investment of the utility

V2B advantages

Fleet aggregation involves fewer barriers

Cars availability is well known

Suited for factories, universities but also electrical public transit

Will certainly occur before individual V2G

Silent and green backup source during outage:

Service most appropriated for user's

Load shedding during peak hours

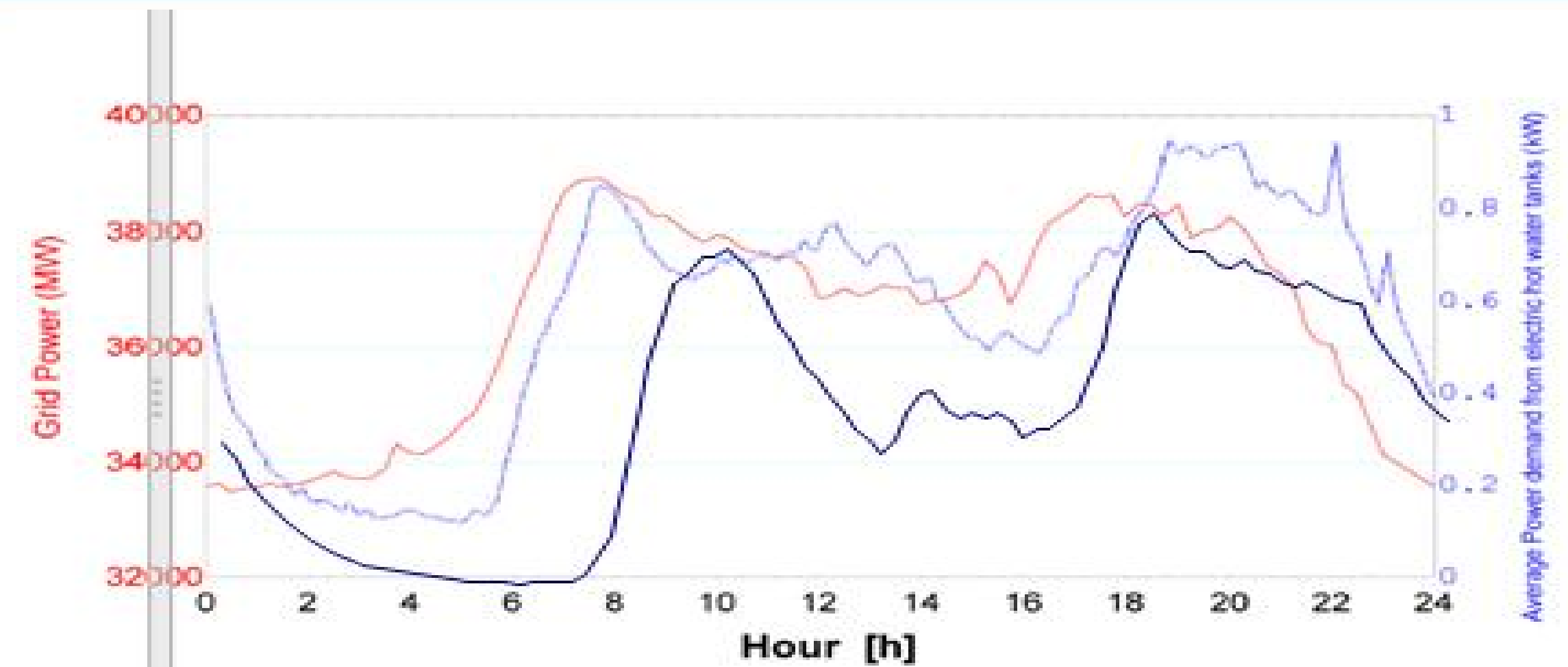
Avoids anti-islanding relay in the charging station



Avoids network modification for reinjection

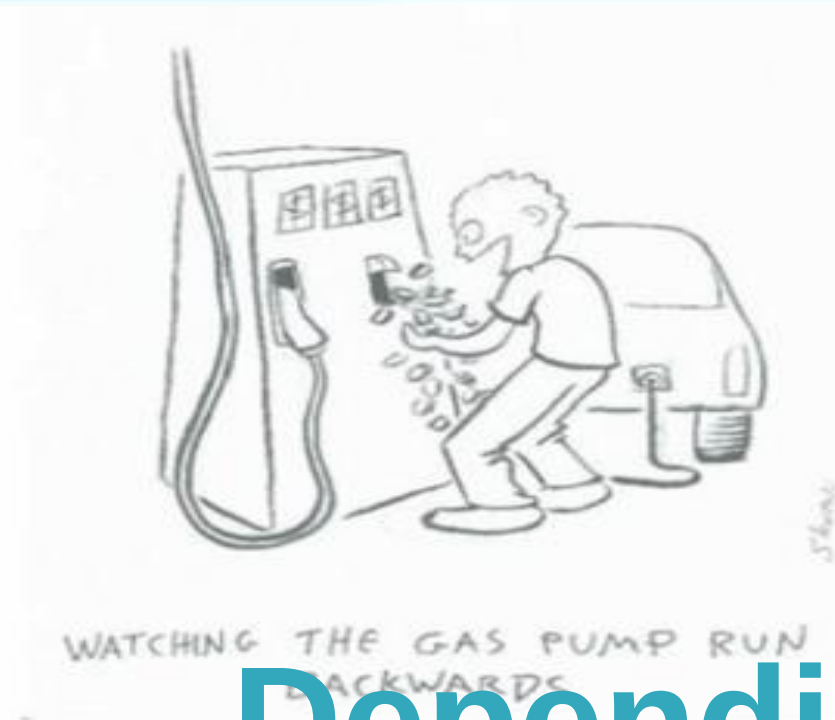
Less expensive solution than V2G but connection to home charges required

Domestic water heater as a thermal energy storage (V1G)



Batteries for network proposed by Esstalion,
(joint venture Hydro-Quebec / Sony)





Depending on the EV adoption

Short term:

V1G (could reduce more than 50% of the actual power demand per EV during the peak hours)

possibility V2H (load shedding)

V2B

Long term:

V2G

*V2B, V2H and V2G have the potential
to increase value of EVs
in the eyes of future drivers.*

*They could also help make
power grids more reliable*

THE ELECTRIC CIRCUIT (HQ subsidiary)

•643

STATIONS



•33

DCFC



•570

Level 2



•40

Curbside



•4700

100% EV



•5300

PHEV



•7400

Members



•75%

%
members

