Meeting Synopsis:

1. Call to order
2. Review of the minutes from November 21, 2019
3. Chair’s comments
4. UW Transportation Services: rate increase -- Anne Eskridge
5. UW Transportation electrification and potential solar development -- Jan Whittington
6. Good of the order
7. Adjourn

1. Call to order

The meeting was called to order at 10:00 a.m.

2. Review of the minutes from November 21, 2019

The minutes from November 21, 2019, were approved as amended.

3. Chair’s comments

Borys explained the Architectural Commission selected the architect for the UW Bothell STEM Building in the body’s December meeting. In its January meeting, the Commission reviewed the Health Sciences Education Building and the Foster School of Business’ new Founders Hall. The new Behavioral Health Teaching Facility underwent architect selection.

After a comment, it was noted Mike McCormick will be invited to a future FCUFS meeting to update on conversations surrounding long-term capital planning.

4. UW Transportation Services: rate increase -- Anne Eskridge

Anne Eskridge, Director of UW Transportation Services, was present to share an update on a Transportation Services Parking Rates proposal as well as information on the U-PASS program. A PowerPoint was shown (Exhibit 1).

Parking

Highlights of FY20 were shared in a slide (Slide 5, Exhibit 1).
Parking challenges were shared in a slide (Slide 6, Exhibit 1). UW Transportation Services has seen increased regional costs, garage and surface lot needs, and the Campus Master plan requires limiting parking spaces, as well.

Barbara Wingerson, Associate Vice President for UW Facilities, shared a financial summary for UW Parking within a slide (Slide 7, Exhibit 1). It was noted the increase in expenses shown at the bottom of the table is largely due to parking modernization and a significant deferred maintenance backlog, and without a program rate change, UW Transportation Services will be operating in a deficit. It was noted the defined spending of renewal dollars is currently being deliberated, and FCUFS will be updated when decisions have been made.

The UW visitor parking rates were shown as they compare to the market rate (Slide 8, Exhibit 1). Data was also shown on the same for UW hospital parking compared to other hospitals in the region (Slide 9, Exhibit 1).

**U-PASS**

It was noted 14,000 total UW staff now have a fully subsidized U-PASS. A larger number of UW faculty and staff pay for a fee-based U-PASS. Librarians and professional staff are currently lobbying for fully subsidized employee U-PASS.

A slide was shown on the impact of a fully-subsidized employee U-PASS (Slide 13, Exhibit 1). It was noted when the pass is made fully subsidized, usage rates increase by a significant percentage, adding to costs. This factor and others has led the projected cost of a fully subsidized U-PASS extension (to professional staff and other non-faculty employees) to be $7,094,849. It was noted the faculty are asked to make their own decision on going ahead with a fully subsidized U-PASS recognizing that it comes at the expense of other faculty-led projects requiring funding. It was noted data shows that faculty as a demographic are the lowest users of public transit on campus. There was a clarification that benefit loads are paid for by the unit the employee resides in.

Eskridge and Wingerson were thanked for providing an update to the council.

### 5. UW Transportation electrification and potential solar development -- Jan Whittington

Jan Whittington, Associate Professor of Urban Design and Planning, was present to share information on the UW Transportation electrification and potential solar development on the Seattle campus. An exhibit was shared as part of the presentation and information referred to in the slides (Exhibit 1).

Whittington noted she is Director of The Urban Infrastructure Lab (UIL) at UW. She noted she seeks to socialize the idea that the UW Seattle campus should switch to renewable energy to move onto the path of carbon neutrality. Whittington also works with UW Solar, a vertically integrated project development group researching and implementing PV (photovoltaics) and EV (Electric Vehicle) infrastructure on University of Washington properties. More information on UW Solar was shared (Slide 4, Exhibit 2).
It was noted the average annualized cost of operation and maintenance is planned to decrease in a solar power system. The latest project undertaken by the UIL was the Life Sciences Building rooftop solar panel. Technical information was shared on the project (Slide 16, Exhibit 2). A member asked how storage capacity works once the solar panel infrastructure is in place. It was noted given the size and amount of energy needed for UW buildings, it is not possible for a solar array on the rooftop to supply more than 15-20% of the building energy demand, and as such there is no need for a storage system.

Electric Vehicles (EVs) improvements were detailed in several slides (Exhibit 2). Washington State laws dictate moving in the EV direction at UW (Slide 18, Exhibit 2). It was noted battery costs are declining, and the prices of owning, maintaining, and operating EVs are also declining. A slide on user demand for EVs was shown (Slide 21, Exhibit 2).

Whittington noted it is known that these types of technologies can financially stand on their own, and some of them will be revenue generators. 36 lots were found on the UW Seattle campus that are suitable for renewable upgrades. Additional preliminary findings were shown in a slide (Slide 39, Exhibit 2). Additional potential renewable projects were detailed.

Members thanked Whittington for presenting. It was noted she will return to the council to provide updates on this initiative.

6. Good of the order

Nothing was stated.

7. Adjourn

The meeting was adjourned at 11:30 a.m.

Minutes by Joey Burgess, jmbg@uw.edu, assistant to the secretary of the faculty

Present: Faculty Code Section 21-61 A: Murray Maitland, Ann Marie Borys (Chair), Ashley Emery, Giovanni Migliaccio, Andy Hoofnagle, Laura Little, Gundula Proksch, Bill Erdly
Faculty Code Section 21-61 B: Alena Wolotira, Bruce Balick
President’s designee: Lou Cariello
Guests: Jan Whittington, Barbara Wingerson, Anne Eskridge

Absent: Faculty Code Section 21-61 A: N/A
Faculty Code Section 21-61 B: John Carroll

Exhibits
Exhibit 1 – 20200130_ParkingRates-FY21-FCUFS.pdf
Exhibit 2 – Combined Master Deck Q1 2020.pdf
Parking rates & U-PASS

Faculty Council on Facilities & Services
January 30, 2020
Agenda

1. **Timeline & communications**

2. **Parking rates**
   - Current state
   - Proposal for FY21

3. **U-PASS**
   - Current state
   - Proposal for FY21
   - Cost to extend full subsidy

4. **Next steps**
Timeline & communications

Mon, Dec 27  UW Medicine
Tues, Jan 7  Intercollegiate Athletics
Mon, Jan 13  **UTC presented with rate proposals**
Thurs, Jan 16  U-PASS Advisory Board
Wed, Jan 22  Graduate & Professional Student Senate
Thurs, Jan 23  Operational Leadership Team
Mon, Jan 27  **UTC votes on rate proposals**
Mon, Jan 27  Faculty Senate Committee on Planning & Budgeting
Wed, Jan 29  **Public hearing at the HUB**
Thurs, Jan 30  Faculty Council on Facilities & Services
Thurs, Jan 30  ASUW
Early Feb  President/Provost approval
Thurs, March 12  Board of Regents
Parking rates
Current state of UW parking

Highlights of FY20

- $2.5 million spent on N22 renovation
- $1.5 million spent on modernization, including pay by phone, integrated systems
- Increased parking rates 12%, first increase in four years
- Expanded PPUP (pay-per-use) program for faculty/staff by 34%
- Policy change regarding TDM fees distribution
Parking challenges

Increased regional costs
- City of Seattle parking taxes (~$2.2M a year, near double since 2015)
- Impact of CPI increases (up 23% since 2010)

Garage and surface lot needs
- The UW has 15 garages and 80+ surface lots, for a total of 3.7 million sqft.
- Deferred maintenance: $53.8 million estimate as of January 2019
- ADA remediation needed to meet compliance with consent decree

Campus Master Plan requires limiting parking spaces
- UW has agreed to achieve 12% SOV rate by 2028, with a 9,000-space cap
- As of 2018, SOV rate is 19%, with 12,200 parking spaces
- Sharp reduction in trips/spaces will reduce parking revenue
## Financial summary for UW parking

<table>
<thead>
<tr>
<th></th>
<th>2018-19 actual</th>
<th>2019-20 projected</th>
<th>2020-21 no rate change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating revenues</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permit</td>
<td>13,165,459</td>
<td>13,050,609</td>
<td>13,050,609</td>
</tr>
<tr>
<td>Gate</td>
<td>5,461,351</td>
<td>5,761,818</td>
<td>5,761,818</td>
</tr>
<tr>
<td>Self service</td>
<td>3,626,704</td>
<td>3,634,933</td>
<td>3,634,933</td>
</tr>
<tr>
<td>Events and miscellaneous</td>
<td>1,168,050</td>
<td>1,244,774</td>
<td>1,240,045</td>
</tr>
<tr>
<td>Parking lot rentals</td>
<td>694,144</td>
<td>694,144</td>
<td>694,144</td>
</tr>
<tr>
<td>Parking Citations</td>
<td>821,932</td>
<td>746,974</td>
<td>700,000</td>
</tr>
<tr>
<td><strong>Gross revenue</strong></td>
<td>24,937,641</td>
<td>25,133,752</td>
<td>25,081,549</td>
</tr>
<tr>
<td>Less: Sales tax</td>
<td>(1,751,340)</td>
<td>(1,832,217)</td>
<td>(1,832,217)</td>
</tr>
<tr>
<td>Less: City parking tax</td>
<td>(2,167,501)</td>
<td>(2,267,595)</td>
<td>(2,267,595)</td>
</tr>
<tr>
<td>Less: TDM fee</td>
<td>(7,129,576)</td>
<td>(7,128,701)</td>
<td>(7,046,573)</td>
</tr>
<tr>
<td>Plus: TDM variance above U-PASS breakeven</td>
<td>981,514</td>
<td>929,126</td>
<td>929,126</td>
</tr>
<tr>
<td>Less: Tax equivs for non-taxable revenue</td>
<td>(498,473)</td>
<td>(388,214)</td>
<td>(388,214)</td>
</tr>
<tr>
<td><strong>Net revenue</strong></td>
<td>13,390,751</td>
<td>14,498,039</td>
<td>14,476,076</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating expenses</td>
<td>9,470,202</td>
<td>9,625,443</td>
<td>11,827,157</td>
</tr>
<tr>
<td>Non-operating expenses</td>
<td>2,562,666</td>
<td>3,148,767</td>
<td>3,366,306</td>
</tr>
<tr>
<td><strong>Expenses total</strong></td>
<td>12,032,868</td>
<td>12,774,210</td>
<td>15,193,463</td>
</tr>
<tr>
<td><strong>End result</strong></td>
<td>1,357,883</td>
<td>1,723,829</td>
<td>(717,387)</td>
</tr>
</tbody>
</table>

More than 40% of parking revenue comes from visitors to campus or other occasional users

Increase due to parking modernization and deferred maintenance
Analysis: U District parking rates

- UW is by far the biggest provider of parking in the area, with 12,200 spaces
- Nearby private lots are competitive on daily rates, but more expensive for monthly
- Street parking in the same area is paid and time restricted:
  - $2.50/hr for 2 hours max (U District core)
  - $1/hr for 4 hours max (U District edge)

<table>
<thead>
<tr>
<th></th>
<th>Daily rate</th>
<th>Monthly rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>UW rate</td>
<td>$17.00</td>
<td>$168.00</td>
</tr>
<tr>
<td>Average non-UW</td>
<td>$14.39</td>
<td>$174.44</td>
</tr>
<tr>
<td>Lowest non-UW</td>
<td>$8.16</td>
<td>$145.00</td>
</tr>
<tr>
<td>Highest non-UW</td>
<td>$24.00</td>
<td>$250.00</td>
</tr>
</tbody>
</table>
Analysis: Hospital parking rates

- UW Medical Center uses the same parking rates as the rest of the UW campus
- These rates were compared to hospitals within a four-mile radius:
  - Harborview, Kaiser Permanente-Capitol Hill, Northwest Hospital, Swedish-Ballard, Swedish-Cherry Hill, Swedish-First Hill and Virginia Mason

<table>
<thead>
<tr>
<th></th>
<th>Daily Visitor Rate</th>
<th>Daily Patient Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>UWMC rate</td>
<td>$17.00</td>
<td>$10.00 with partial validation</td>
</tr>
<tr>
<td>Average non-UW</td>
<td>$15.64</td>
<td>$15.14</td>
</tr>
<tr>
<td>Lowest non-UW</td>
<td>$8.00</td>
<td>$8.00</td>
</tr>
<tr>
<td>Highest non-UW</td>
<td>$20.00</td>
<td>$20.00</td>
</tr>
</tbody>
</table>

A literature review of published studies shows that parking costs at a hospital was a non-factor in a customer’s decision to seek treatment at a hospital.
## Parking rate proposal for FY21

<table>
<thead>
<tr>
<th>Product</th>
<th>Current</th>
<th>4% increase</th>
<th>8% increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitor parking</td>
<td>$4/hour $17/day</td>
<td>$4/hour $18/day</td>
<td>$4/hour $19/day</td>
</tr>
<tr>
<td>Single occupancy vehicle (faculty &amp; staff)</td>
<td>$168/month $504/quarter</td>
<td>$175/month $525/quarter</td>
<td>$182/month $546/quarter</td>
</tr>
<tr>
<td>Pay per use parking (faculty &amp; staff)</td>
<td>$8.40/day</td>
<td>$8.75/day</td>
<td>$9.10/day</td>
</tr>
<tr>
<td>Student parking &amp; value parking lot</td>
<td>$6.75/day</td>
<td>$7.00/day</td>
<td>$7.30/day</td>
</tr>
</tbody>
</table>

| Financial result | ($ .72 million) | $0 break-even | $.67 million |
U-PASS
Current state – Student U-PASS

Note: This is informational only. Student U-PASS rates are set by the Universal Student U-PASS Advisory Board. The UTC does not vote on them.

Universal Student U-PASS ($84/quarter) 45,472

Fully subsidized U-PASS (academic student employees) 4,191

Total students with U-PASS 49,663

Program note

• The last increase for the Universal Student U-Pass was 5% in FY2015. Since then, U-PASS costs have gone up 13%.
Current state – Employee U-PASS

Fully subsidized U-PASS benefit
14,000 total, including:
• classified staff (ratified)
• classified staff (non-union)
• post-docs

Fee-based U-PASS ($50/month)
4,000 classified staff (non-ratified)
10,500 professional staff
20,000 faculty
500 temporary/hourly staff

Program pressures
• U-PASS costs have increased 13% since 2015, with no change in monthly rate
• Direct payments to transit agencies are 98% of U-PASS costs
• Transit costs to rise in FY22 and beyond with Link light rail expansion
• Unknown impact of Initiative 976, which limits state funding to transit
• Professional Staff Organization lobbying for fully subsidized U-PASS
### Impact of fully subsidized employee U-PASS, FY20-FY21

<table>
<thead>
<tr>
<th></th>
<th>FY20</th>
<th>FY21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Projected cost</td>
<td>Benefit load rate</td>
</tr>
<tr>
<td><strong>Classified staff &amp; post-docs</strong>*</td>
<td>$7,312,410</td>
<td>0.8157%</td>
</tr>
<tr>
<td><strong>Academic student employees</strong></td>
<td>$1,351,124</td>
<td>1.1197%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$8,663,534</td>
<td></td>
</tr>
</tbody>
</table>

*Includes currently eligible classified staff (those with ratified contracts and those not in unions) and UAW-represented post-docs at the Seattle, Tacoma and Bothell campuses as well as at UW Medical Center-Montlake, UW Medical Center-Northwest and Harborview.
## Projected costs for fee-based employee U-PASS (Seattle only), FY21

<table>
<thead>
<tr>
<th></th>
<th>Professional</th>
<th>Classified</th>
<th>Temps</th>
<th>UWEO</th>
<th>Faculty</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User fees</td>
<td>2,603,530</td>
<td>556,573</td>
<td>365,533</td>
<td>255,792</td>
<td>551,085</td>
<td>4,332,513</td>
</tr>
<tr>
<td><strong>Subsidies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDM</td>
<td>613,574</td>
<td>-</td>
<td>-</td>
<td>128,188</td>
<td>120,807</td>
<td>796,430*</td>
</tr>
<tr>
<td>General Subsidy</td>
<td>804,276</td>
<td>134,616</td>
<td>79,376</td>
<td>95,995</td>
<td>167,973</td>
<td>1,282,236</td>
</tr>
<tr>
<td>Benefit load-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Costs</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total UW subsidies</strong></td>
<td>1,417,850</td>
<td>134,616</td>
<td>79,376</td>
<td>224,183</td>
<td>288,780</td>
<td>2,144,805</td>
</tr>
<tr>
<td><strong>Total Funding</strong></td>
<td>4,021,380</td>
<td>691,189</td>
<td>444,909</td>
<td>479,975</td>
<td>839,865</td>
<td>6,411,179</td>
</tr>
</tbody>
</table>

|                      |              |            |         |          |           |             |
| **Expenses**         |              |            |         |          |           |             |
| Baseline Transit Cost| 3,784,706    | 658,639    | 388,380 | 471,175  | 802,616   | 6,105,516   |
| New Transit Cost     |              |            |         |          |           |             |
| Admin Costs          | 236,674      | 14,442     | 8,498   | 8,799    | 37,249    | 305,663     |
| **Total Expenses**   | 4,021,380    | 673,082    | 396,878 | 479,975  | 839,865   | 6,411,179   |

*Total TDM subsidy adjusted across all fee-based employee U-PASS groups to break even.
Fee-based U-PASS proposal for FY21

Transportation Services recommends keeping the monthly rate for the fee-based U-PASS at $50 for the Seattle campus, with no increase.
Extending the U-PASS subsidy

**Note:** Informational only. A decision to extend the fully subsidized U-PASS would come from the president’s and provost’s offices or through additional bargaining agreements.

Projected costs on the next two slides are based on these assumptions for an extended full U-PASS subsidy in FY21:

- Funded by the benefit load, following last year’s precedent
- Extended to professional staff, classified staff in non-ratified contracts and temporary staff
- Faculty make this decision for themselves
- Applies at all locations: Seattle, Bothell, Tacoma, UWMC-Montlake, UWMC-Northwest and Harborview
- Transit usage (and thus costs) would go up 25% based on anticipated behavior change by newly benefited staff
- Population growth of 2% from FY20
## Projected costs of extending fully subsidized U-PASS, FY21

<table>
<thead>
<tr>
<th></th>
<th>Professional</th>
<th>Non-Ratified</th>
<th>Temps</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User fees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subsidies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benefit load—General Subsidy</td>
<td>1,057,929</td>
<td>229,856</td>
<td>131,185</td>
<td>1,418,970</td>
</tr>
<tr>
<td>Benefit load—Additional Costs</td>
<td>4,231,714</td>
<td>919,423</td>
<td>524,741</td>
<td>5,675,878</td>
</tr>
<tr>
<td><strong>Total UW subsidies</strong></td>
<td>5,289,643</td>
<td>1,149,279</td>
<td>655,926</td>
<td>7,094,848</td>
</tr>
<tr>
<td><strong>Total Funding</strong></td>
<td>5,289,643</td>
<td>1,149,279</td>
<td>655,926</td>
<td>7,094,848</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Transit Cost</td>
<td>4,131,772</td>
<td>927,811</td>
<td>532,822</td>
<td>5,592,405</td>
</tr>
<tr>
<td>New Transit Cost</td>
<td>921,197</td>
<td>207,026</td>
<td>114,606</td>
<td>1,242,828</td>
</tr>
<tr>
<td>Admin Costs</td>
<td>236,674</td>
<td>14,442</td>
<td>8,498</td>
<td>259,615</td>
</tr>
<tr>
<td><strong>Total Expenses</strong></td>
<td>5,289,643</td>
<td>1,149,279</td>
<td>655,926</td>
<td>7,094,848</td>
</tr>
</tbody>
</table>
## Impact of extending subsidy, FY21

<table>
<thead>
<tr>
<th>Class</th>
<th>Projected cost</th>
<th>Benefit load rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classified staff &amp; post-docs*</td>
<td>$8,155,319</td>
<td>0.8018%</td>
</tr>
<tr>
<td>Classified staff with non-ratified contracts</td>
<td>$1,149,279</td>
<td>0.1130%</td>
</tr>
<tr>
<td>Total classified staff</td>
<td>$9,304,599</td>
<td>0.9148%</td>
</tr>
<tr>
<td>Professional</td>
<td>$5,289,643</td>
<td>0.5122%</td>
</tr>
<tr>
<td>Temporary/hourly employees</td>
<td>$655,926</td>
<td>0.3061%</td>
</tr>
<tr>
<td>Academic student employees*</td>
<td>$1,456,377</td>
<td>1.3267%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$16,706,545</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total additional cost of extension</strong></td>
<td><strong>$7,094,849</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Already covered by the fully subsidized U-PASS as of July 1, 2019.*
Next steps

1. Stakeholders socialize information with their groups
2. Proposed rates posted on TS website, Jan 16
3. UTC votes on rate proposals on Mon, Jan 27
4. Public hearing at the HUB on Wed, Jan 29
5. President/Provost approval in early February
6. Board of Regents votes on Thurs, March 12
Solar Viability at UW

January 2020

UW - SOLAR

An interdisciplinary, student-run solar project at the University of Washington
Campus EV and PV
DRAFT Findings, FCUFS, January 2020

Exhibit 2
UW Solar

A vertically integrated project development group researching and implementing PV and EV infrastructure on University of Washington properties.

Dr. Jan Whittington
Associate Professor Urban Design & Planning
Director of the Urban Infrastructure Lab

Whitney Thomas
PhD Student
Aeronautics and Astronautics
What we do

Project Development & Implementation:

- Site Evaluation/Shading Analysis
- PV System Preliminary Design
- Cost Estimation & Financial Modeling
- Policy Review
- Procurement of Funding
- RFP Drafting
- Contractor Selection
- Reviewing of Installation & Commissioning

Research and Advising:

- Research and evaluation of PV & EV technologies
- Compile Databases of Available Technologies
- Financial Modeling
- Decision Making Models
# Projects

## Completed Projects:

**Residence Halls**
- Mercer A: 35kW
- Alder: 50kW
- Elm: 25kW
- Maple: 25kW

**Life Sciences Building**
- Rooftop Array: 100kW
- BIPV Shading Fins: 5kW

## Plans (wrapping up in February):

- **UW Transportation PV & EV**
  
  A strategy to electrify UW Transportation services by 2030 integrated with solar investment

- **UW Campus Solar Plan**
  
  A plan to implement solar opportunities on the UW Seattle Campus
Policy Shift - Utility Decarbonization

SB 5116 - CETA Clean Energy Transformation Act (enacted May, 2019)

- **2025 Coal Elimination Standard**
  Requires all electric utilities to eliminate coal-fired resources from their allocation of electricity by December 31, 2025

- **2030 Carbon Neutral (GHG Neutral Standard)**
  Requires that all retail sales of electricity to Washington customers be greenhouse gas neutral by January 1, 2030

- **2045 Carbon Free (Clean Energy Standard)**
  Requires each electric utility to demonstrate that it’s using a combination of nonemitting electric generation and electricity from renewable Resources by January 1, 2045
Objectives

**Sustainability:** Improve UW’s STARS rating and carbon neutrality goal of Climate Action Plan

**Resilience:** Solar + Storage can serve as emergency power for critical infrastructure.

**Decarbonization:** Assist in campus planning for carbon neutral capital investments

**Education:** Provide real energy planning and project experience to UW students.

**Research:** Providing testbed for solar pv, battery storage, ev charging and smart grid technologies.

**Outreach:** Educate UW community on sustainability of renewable energy.

**Leadership:** Providing guidance to region on solar and transportation electrification.
Objectives

**Sustainability:** Improve UW’s STARS rating and carbon neutrality goal of Climate Action Plan

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Mercer A Installation

**Student Team:** Duncan Clauson, Michele Hill, Kristen Gelino, Bruce Reed, Allison McGrath, Jeff Bernard, Lydia Fulton, Sunni Wissmer, Casey Rodgers, Otis Alexander, Lucas Reber, Jonathan Olds, Nick Steckler, Kaiwen Sun, Justin Brecese, and Stefanie Young

**Faculty Adviser:** Jan Whittington

**UW Staff:** JR Fulton, Josh Gana, Lyndsey Cameron, Guarrin Sakagawa, Jon Lebo, John Chapman and many more

**Project Stats:**
- Completed Spring 2014
- System Size 35 kW
CEI/PNW Smart Grid Testbed

Project Stats:
Completed Winter 2017
System Size 105 kW

Maple - 25.2 kW System (+5 kw)
Alder - 49.84 kW System
Elm - 25.48 kW System


Faculty: Jan Whittington, Chris Lee, Daniel Kirschen, Miguel Ortega-Vazquez

UW Staff: JR Fulton, Dave Hadaway, Aaron Neal, Henrietta Cottingham, Norm Mentor, Marilyn Ostergren and many more
Port of Seattle

Student Team: Alex Ratcliff, Kenneth Wilhelm, Christoph Strouse, Yuxuan Chen, Jecca Canet, Wade Phillips, Shuheng Wang, Car Janz, Rebecca Perkins, Collin Topper, Ishana, Sharma, Jiawen Gao, Hakim Hamid, Vijay Singh, Logan Chun, Prerna Agarwal, Justin Miller, Jonathan Mun, Teresa Wang, Chanku Lee, Austin Bell, Shruti Misra, Lauren Hoerr, Bry Osmonson, Trinh, Joylyn, Adam Krout, Yingying Cai, Stefanie Young

Faculty: Jan Whittington

Port of Seattle: Terrance Darby

Terminal 5 Feasibility Study:
3+ MW on a (methane-capped landfill)

Campus Multi-Criteria Analysis
7 projects:
• Maritime Industrial Center: 79.2 - 127.8 kW
• Parking Center: 568.8 - 589.8 kW
• Terminal 91: 533.4 - 597 kW
• Terminal 102: 546.3 - 564.6 kW
• Terminal 104: 341.1 - 358.2 kW
• Terminal 106: Approx 4.8 MW
Life Sciences Building

**Student Team:** Alex Ratcliff, Wade Phillips, Kenneth Wilhelm, Christoph Strouse, Yuxuan Chen, Jecca Canet, Shuheng Wang, Cary Janz, Rebecca Perkins, Collin Topper, Ishana Sharma, Jiawen Gao, Hakim Hamid, Vijay Singh, Jonathan Mun, Teresa Wang, Stefanie Young

**Faculty:** Jan Whittington

**UW Staff:** JR Fulton, Dave Hadaway, Aaron Neal, Henrietta Cottingham, Norm Mentor, Marilyn Ostergren, Steve Babinec, Dave Hurley and many more

**Project Stats:**
- **Rooftop System:** 100 kW
- **Completion Date:** Jan. 2020
- **BIPV System Size:** 5 kW
- **Completion Date:** Sept 2018
Population Health Facility

**Project Stats:**
- Completion Date: Approx 2021
- System Size: Approx. 100 kW

**Student Team:** Alex Ratcliff, Kenneth Wilhelm, Christoph Strouse, Yuxuan Chen, Hakim Hamid, Vijay Singh, Teresa Wang, Stefanie Young

**Faculty:** Jan Whittington

**UW Staff:** Jeannie Natta
PV Policy

2015 Seattle Energy Code:
- Requires solar ready roof and a minimum of 0.25 watts of renewable energy per square foot of conditioned floor area.

- Next code cycle:
  2018 Seattle Energy Code Effective Date: July 1, 2020 - January 1, 2021

- Seattle AIA Code Roundtable, is recommending that new code require full solar capacity per roof area.

HB 1257 - Building Energy Efficiency
- Requires the Department of Commerce to establish a State Energy Performance Standard for covered commercial buildings by November 1, 2020.

- Resolution 20380:
  Seek up to 20% enhanced energy efficiency beyond current version of ASHRAE/IESNA Standard 90.1
PV Mythbusting

O & M cost near zero:
- Maintenance is minimal
- Wash every 5 years (like windows)
- UW window washing rate: $48/hr
- Warranties are typically 25-35 years
- Panels work well beyond warranty date
- Panels and systems can be moved

It’s affordable and falling:
- Capital costs continue to decline
- Install costs have dropped >50% in the past 5 years
- SCL costs continue to climb (5.4% increase per year)
- Cost over the lifespan is now cheaper than buying power from SCL
- Break even point for SCL cost is now $3.00/W
- Latest UW project $2.80/W
If used to offset power from Seattle City Light:

**Actual Cost:**
- Utility savings: $8,800 in 1st yr ($626,455/30 yrs)
- Simple “payback”: 19 yrs

**SCL 6kW Cost ($2.55/w):**
- Simple “payback”: 18 yrs

**SCL 100kw Cost ($1.95/w):**
- Simple “payback”: 15 yrs

---

**Project Details:**
- Location: Life Science Building
- Panels: Silfab 350W
- Mounting: rooftop, ballasted rack
- Inverter: SolarEdge optimizers + central inverter
- Array size: 286 panels
- Power capacity: 100 kW
- Annual production: 100 MWh/yr
- Capital cost: $280,750
- Actual Cost per watt: $2.80/watt
PV at Scale

Cost factors
- Larger projects cost less
- 300+ UW Buildings assessed

Capacity for PV on UW Seattle Buildings
- 53 Category A (post 1990)
- 4.8 MW Power (4.87 GWh/year Energy)
- 53 Category B (pre 1990)
- 10.2 MW Power (10.3 GWh/year Energy)

Average Annual Costs Compared
- Per GWh/yr system cost: $85,600
- Per GWh/yr SCL cost: $174,000
- Avoided cost/GWh/yr: $88,413
- Potential total avoided cost/yr: $2,033,500
EV Policy

Seattle EV Ordinance:
- New parking spaces on a lot of a newly constructed building must be EV-ready
- For nonresidential use parking (off-street parking, in a lot) a minimum of 10% of stalls should be EV-ready

Seattle City Lights rate increase:
- Current Rate:
  - Peak (Larger Service Area) - $0.0886
  - Off Peak (Larger Service Area) - $0.0584
  - Average - $0.0735
- Effective Jan 1st 2020, rates increase by approximately 5.4% on average

WA State Laws:
- All state agencies must, to the extent practicable, use 100% biofuels or electricity to operate all publicly owned vehicles
- Agencies must prioritize EVs when leasing or purchasing new vehicles, and all trips that may feasibly use EVs must employ them
## Electrification of UW Transportation Services

### Strategy to Electrify by 2030
1. UW Fleet - ICE to EV
2. Parking with Charging
3. Integration with Solar

### Exhibit 2

<table>
<thead>
<tr>
<th>Vehicle Type at UW Transportation</th>
<th>Number of Vehicle (09/2019)</th>
<th>EV Year Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedan</td>
<td>145</td>
<td>Current</td>
</tr>
<tr>
<td>Compact/Pickup Truck</td>
<td>135</td>
<td>Current - 2021</td>
</tr>
<tr>
<td>Mini/Regular Cargo Van</td>
<td>130</td>
<td>2021</td>
</tr>
<tr>
<td>Minivan/SUV</td>
<td>107</td>
<td>Current</td>
</tr>
<tr>
<td>Large Cargo Van</td>
<td>43</td>
<td>2022</td>
</tr>
<tr>
<td>Box Truck</td>
<td>32</td>
<td>2024</td>
</tr>
<tr>
<td>Large SUV</td>
<td>23</td>
<td>Current - 2021</td>
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<tr>
<td>Bus</td>
<td>7</td>
<td>Current</td>
</tr>
<tr>
<td>Shuttle Vans</td>
<td>7</td>
<td>2022</td>
</tr>
<tr>
<td>Hybrid Stepvan</td>
<td>7</td>
<td>Current</td>
</tr>
<tr>
<td>Packer-Refuse Trucks</td>
<td>5</td>
<td>2024</td>
</tr>
<tr>
<td>30-Passenger Shuttles</td>
<td>3</td>
<td>2021</td>
</tr>
<tr>
<td>Low Speed Vehicles</td>
<td>2</td>
<td>Current</td>
</tr>
<tr>
<td>Street Sweeper</td>
<td>1</td>
<td>2021</td>
</tr>
<tr>
<td>Vehicles That Fuel at UW Fleet</td>
<td>20</td>
<td>N/A</td>
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<tr>
<td>Fleet Managed Department Owned Veh</td>
<td>54</td>
<td>N/A</td>
</tr>
</tbody>
</table>
**EV Market Factors**

**O & M**

- eMPG 125 (Sedans)
- 35% less maintenance cost
- 291,500 gallons/year of fuel
- $646,000/year in fuel
- **1.1 - 3.4 GWh/year to charge fleet**
- 10-20% of lot surface in solar
- $486,000/year to charge fleet

**Prices are falling**

- Capital costs **decline** over time (per make and model)
- Vehicle types coming to market through 2024
- Install costs for slow chargers $3,000
- Forecasting public charging installation against market penetration

EV Battery pack costs from technical studies and automaker statements
EV User Demand

EV Use and Charging

- EV Market Penetration
- UW Fleet use characteristics

<table>
<thead>
<tr>
<th>Year</th>
<th>Projected # of EV in (Edison)</th>
<th>More conservative (Bloomberg)</th>
<th>More aggressive (Bloomberg)</th>
<th>Average</th>
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<tbody>
<tr>
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<td>325</td>
<td>404</td>
<td>404</td>
<td>365</td>
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<td>466</td>
<td>622</td>
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<tr>
<td>2022</td>
<td>606</td>
<td>841</td>
<td>841</td>
<td>724</td>
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<tr>
<td>2023</td>
<td>747</td>
<td>1050</td>
<td>1050</td>
<td>903</td>
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<td>2024</td>
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<td>2028</td>
<td>1449</td>
<td>2153</td>
<td>2153</td>
<td>1801</td>
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<td>2029</td>
<td>1589</td>
<td>2371</td>
<td>2371</td>
<td>1980</td>
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<tr>
<td>2030</td>
<td>1730</td>
<td>2590</td>
<td>2590</td>
<td>2160</td>
</tr>
</tbody>
</table>

How far would you need to reliably go without stopping to charge a future electric vehicle?
356 responses
EV and PV Integration

- 36 Lots (29 surface, 7 garage)
- 13.6 MW Power
- 12.6 GWh/year Energy
- $3.5 M capex
- $423,000 fuel avoided
Comparing PV and EV Payback

Project Details:
- Location: Life Science Building
- Panels: Silfab 350W
- Mounting: rooftop, ballasted rack
- Inverter: SolarEdge optimizers + central inverter
- Array size: 286 panels
- Power capacity: 100 kW
- Annual production: 100 MWh/yr
- Capital cost: $280,750
- Cost per watt: $2.80/watt

If used to offset power from Seattle City Light:
- Utility savings: $7,800 in 1st yr ($833,000/40 yrs)
- Carbon savings: 0.5 MT/yr (20 MT/40 yrs)
- Simple “payback”: 21 yrs

If used to offset transportation fuel:
- Miles of EV charging: 400,000 miles/yr
- Fuel savings: $75,000/yr ($3,000,000/40 yrs)
- Carbon savings: 190 MT/yr (7,600 MT/40 yrs)
- Simple “payback”: 3.7 yrs
PV Mythbusting

O & M cost near zero:
- Maintenance is minimal
- Wash every 5 years (like windows)
- UW window washing rate: $48/hr
- Warranties are typically 25-35 years
- Panels work well beyond warranty date
- Panels and systems can be moved

It's cheaper than you think and falling:
- Capital costs continue to decline
- Install costs have dropped >50% in the past 5 years
- SCL costs continue to climb (4.5% increase per year)
- Cost over the lifespan is now cheaper than buying power from SCL
- The bigger the project, the cheaper the cost per watt (now at $1.83/watt)

NREL 2018 cost benchmark: Declining Solar Costs

Latest UW project at $2.80/W installed cost

Most recent UW Solar project is well below at $2.80/watt installed cost, despite being well above going rate for similarly sized systems. Other projects in Seattle suggest future installations can easily be under $2.00/watt.

The LSB project offsets power from Seattle City Light:
- Utility savings: $7,800 in 1st yr ($434,700/30 yrs)
- Net revenue at end of warranty: $150,050
- Simple “payback”: 22 yrs

Project Details:
- Location: Life Sciences Building, UW Seattle
- Installed: Summer 2019
- Panels: Silfab 350W
- Module output warranty: 30 yrs
- Mounting: penetrationless ballasted rack
- Inverter: SolarEdge optimizers + central inverter
- Array size: 286 panels
- Power capacity: 100 kW
- Annual production: 100 MWh/yr
- Capital cost: $280,750
- Cost per watt: $2.80/watt

SCL break-even point at $3.00/watt
ECONOMIC MODELS - In progress

- Life Cycle Cost Analysis - NIST
  - Supplementary Measures
    - Adjusted Internal Rate of Return
    - Simple and Discounted Payback
- Levelized Cost Of Energy & Levelized Avoided Cost of Energy - EIA
  - LCOE “represents the average revenue per unit of energy production that would be required by a project owner to recover all investment and operating costs.”
  - LACE “represents the potential revenue available to the project owner from the sale of energy and generating capacity.”
  - Both measured in $/kWh
- System Advisor Model - NREL
Project Details:

- Location: UW Seattle Campus
- Installed: TBD
- Panels: 350W
- Mounting: parking garage canopy, flush mount
- Inverter: String inverters
- Array size: 1,064 panels
- Power capacity: 370 kW
- Annual production: 350 MWh/yr
- Cost per watt: $4.43/watt

Canopy structure raises capital costs, but with the benefit of providing covered parking. In addition, solar energy helps meet demand from transportation electrification. When used to charge electric vehicles, solar offsets fuel costs.

Payback considering avoided fuel costs:

- Equivalent EV miles of charging: 1,050,000 miles/yr
- Fuel savings: $197,500 in 1st yr ($5,926,000/30 yrs)
- Simple “payback”: 8 yrs
Portage Bay Garage East Canopy

Project Details:

Canopy structure raises capital costs, but with the benefit of providing covered parking. In addition, solar energy helps meet demand from transportation electrification. When used to charge electric vehicles, solar offsets fuel costs.

Payback considering avoided fuel costs:

- Equivalent EV miles of charging: 1,050,000 miles/yr
- Fuel savings: $197,500 in 1st yr ($5,926,000/30 yrs)
- Net profit at end of warranty: $4,446,000
- Simple “payback”: 8 yrs

Project Details:

- Location: UW Seattle Campus
- Installed: TBD
- Panels: 350W
- Mounting: parking garage canopy, flush mount
- Inverter: String inverters
- Array size: 1,064 panels
- Power capacity: 370 kW
- Annual production: 350 MWh/yr
- Capital cost: $1,480,000
- Cost per watt: $4.00/watt
Preliminary E Lot Array Designs

5.97 MW Nameplate
6.94 GWh Annually
KWh/KWp Efficacy: 1,162.4
5° Tilt

2.69 MW
3.21 GWh
1,192.0 Efficacy
10° Tilt

2.94 MW Nameplate
3.658 GWh Annually
1,245.4 Efficacy
20° Tilt
E Lots Electrical Infrastructure
E Lots Electrical Infrastructure
E-lot Canopy (Maximized Capacity)

Project Details:

Canopy structure raises capital costs, but with the benefit of providing covered parking. In addition, solar energy helps meet demand from transportation electrification. When used to charge electric vehicles, solar offsets fuel costs.

5.97 MW Nameplate
6.94 GWh Annually
KWh/KWp Efficacy: 1,162.4
5° Tilt
Local school district competitive bid results:

Commercial scale PV arrays for public buildings in the Seattle area are regularly seeing bids under $2.00/watt. A series of bids for Shoreline School District shows current market rates averaging $1.80/watt.

The Shoreline SD array offsets power from Seattle City Light:

- Utility savings: $21,400 in 1st yr ($889,700/25 yrs)
- Net profit at end of warranty: $431,700
- Simple “payback”: 15 yrs

Project Details:

- Location: Parkwood Elementary, Shoreline SD
- Bid year: 2018
- Panels: SolarWorld AG 340W
- Mounting: standing seam metal roof, flush
- Inverter: Solectria, 3x60 kW & 1x28kW
- Module output warranty: 25 yrs
- Array size: 748 panels
- Power capacity: 254 kW
- Annual production: 275 MWh/yr
- Installed cost: $449,869
- Cost per watt: $1.77/watt
# UW Transportation: Project Options 2019

A Strategy for Electrifying UW Transportation, in association with Solar Development

<table>
<thead>
<tr>
<th>Comparison of Options</th>
<th>Option 1: Portage Bay Garage vertical mount + battery</th>
<th>Option 2: Ground lot - carport pilot project</th>
<th>Option 3: Parking garage solar canopy</th>
<th>Option 4: Portable solar EV charging stations with battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size:</td>
<td>113 panels</td>
<td>250 panels</td>
<td>180 panels</td>
<td>4 units (4.3kW ea)</td>
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<tr>
<td>Power:</td>
<td>30 kW</td>
<td>70 kW</td>
<td>54 kW</td>
<td>17.2 kW</td>
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<tr>
<td>Annual Energy Generation:</td>
<td>23 MWh</td>
<td>70 MWh</td>
<td>54 MWh</td>
<td>24 kWh</td>
</tr>
<tr>
<td>Cost:</td>
<td>$180 - 250k (w/ battery)</td>
<td>$210 - 280k</td>
<td>$216 - 270k</td>
<td>$228k</td>
</tr>
<tr>
<td>Miles of EV charging:</td>
<td>200 miles/day (set by batt, not PV)</td>
<td>N/A</td>
<td>N/A</td>
<td>260 miles/day*</td>
</tr>
</tbody>
</table>

Feasibility Study Completion: 2019  
System Size: 20-70 kW  
Cost: $250,000
Solar structures can provide other benefits

- **Building or parking garage canopies.** Continuous solar covering above parking area or mechanical systems. Example: Portage Bay Garage. Benefits: covered parking, avoided maintenance, reduce heat island effect, power for EVs (offset fossil fuel costs).

- **Parking lot carports.** Solar structure over individual rows of parking. Examples: Bowman building, E1 parking lot. Benefits: covered parking, rainwater diversion, power for EVs.

- **Shading fins.** Vertical or horizontal solar fins on facades of buildings. Example: Life Sciences Building. Benefits: reduced cooling load.

- **Vertical mount.** Solar panels mounted to the sides of buildings or other structures. Example: Husky Stadium. Benefits: even year round generation profile, public visibility,

- **Modular installations.** Standalone solar/battery systems for small loads. Example: lighted crosswalk signs, street lights, public laptop/cell phone charging kiosks. Benefits: minimal electrical infrastructure, portability, low maintenance.
The Big Picture for UW

Solar projects support learning, research and larger goal of campus sustainability:

- Campus Solar Plan should be part of the upcoming Campus Sustainability Plan
- A revolving fund is needed to capture savings and reward sustainable investments
- UW in the future will need more electricity to offset the natural gas going to the Steam Plant
- UW Solar is working with Transportation Services on EV charging and electrification
- Fleet electrification will add another 1 GWh/yr to existing loads (~1 MW solar array)
- Solar + Storage on garages and parking can offset fleet electrification demand
- Solar + Storage can offset peak load and create a more resilient smart grid
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- **2045 Carbon Free (Clean Energy Standard)**
  Requires each electric utility to demonstrate that it’s using a combination of nonemitting electric generation and electricity from renewable Resources by January 1, 2045
Preliminary Findings

Goal:
- Develop capital & financial strategy
- Fit in 100% carbon free timeframe (2045)

Findings:
- Renewable generation to decarbonize
- PV capacity = 10% of campus energy
- PV timing = peak load period
- EV Fleet demand = 10-12% of lot capacity
- All result in cost savings
- Assembled database of 358 existing structures owned or leased by UW in the U District.
- Evaluated 300 buildings and all lots for PV based on: solar exposure, roof type, age, roof obstruction.

Current results:
- Ready for solar, built after 1990:
  - 53 buildings @ 4.8 MW
- Ready for solar, built before 1990:
  - 119 buildings @ 10.2 MW
- Ready for solar, built before 1990:
  - 36 lots @ 13.6 MW
Questions

Contact Information:  
**Stefanie Young**, Project Manager: sy10@uw.edu  
**Jan Whittington**, Faculty Advisor: janwhit@uw.edu
Another Solar Array Please (ASAP)

An initiative to allow individuals to crowdfund UW Solar’s next project.

$2/w
Current Projects – Burke Museum
Entire complex approximately **530 kW**

*Starting with smaller complex not included in initial sizing*
Current Projects – Bowman Building

Approximately 30 kW
Financial Measures

Capital Costs

- **Starting budget**: ~$250,000
- **Cost per size plus canopy**: $3-5 per watt (~$4,000 per kW)
- **Drainage (solar as secondary roof)**: Minor added cost

Solar Payback

- **Offset payment to SCL**: Rates projected to climb from $78/MWh (2020) to $430/MWh (2060)
- **Offset gasoline/diesel purchases**: Current fuel expenditures ~$650,000 a year
- **Reduced maintenance**: Full roof install offsets $389,000 to recoat top floor of Portage Bay Garage
## Database of Technologies

<table>
<thead>
<tr>
<th>Company</th>
<th>Item Name</th>
<th>RAW Price</th>
<th>Surface area</th>
<th>Power</th>
<th>Weight</th>
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<tbody>
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</table>

## Market Availability & Factors

- PV Panels & Films
- Inverters
- Mounting hardware
- Batteries
- Electric vehicle charging systems
- Electric vehicles
- Other demand side analytics

## Exhibit 2

- Data regarding market availability and factors for various technologies, including costs, power density, and weight per square meter.
# Financial Modeling

## Inputs:
- Installation costs
- Future energy prices
- Maintenance costs
- Interest rates
- Carbon costs
- Potential fuel savings

## Outputs:
- Payback period
- Return on Investment (ROI)
- Net Present Value
- Internal Rate of Return (IRR)
- Annualized Return on Investment

### Exhibit 2

<table>
<thead>
<tr>
<th>Energy Only</th>
<th>40 Years</th>
<th>Discount Rate 2.5%</th>
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<td><strong>Outputs:</strong></td>
<td><strong>Options:</strong></td>
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<td>Installation costs</td>
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<td>Future energy prices</td>
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<td><strong>Total ROI (40 years)</strong></td>
<td><strong>Total ROI (40 years)</strong></td>
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Total PVP System Returns

Exhibit 2

[Image: UW-Solar]