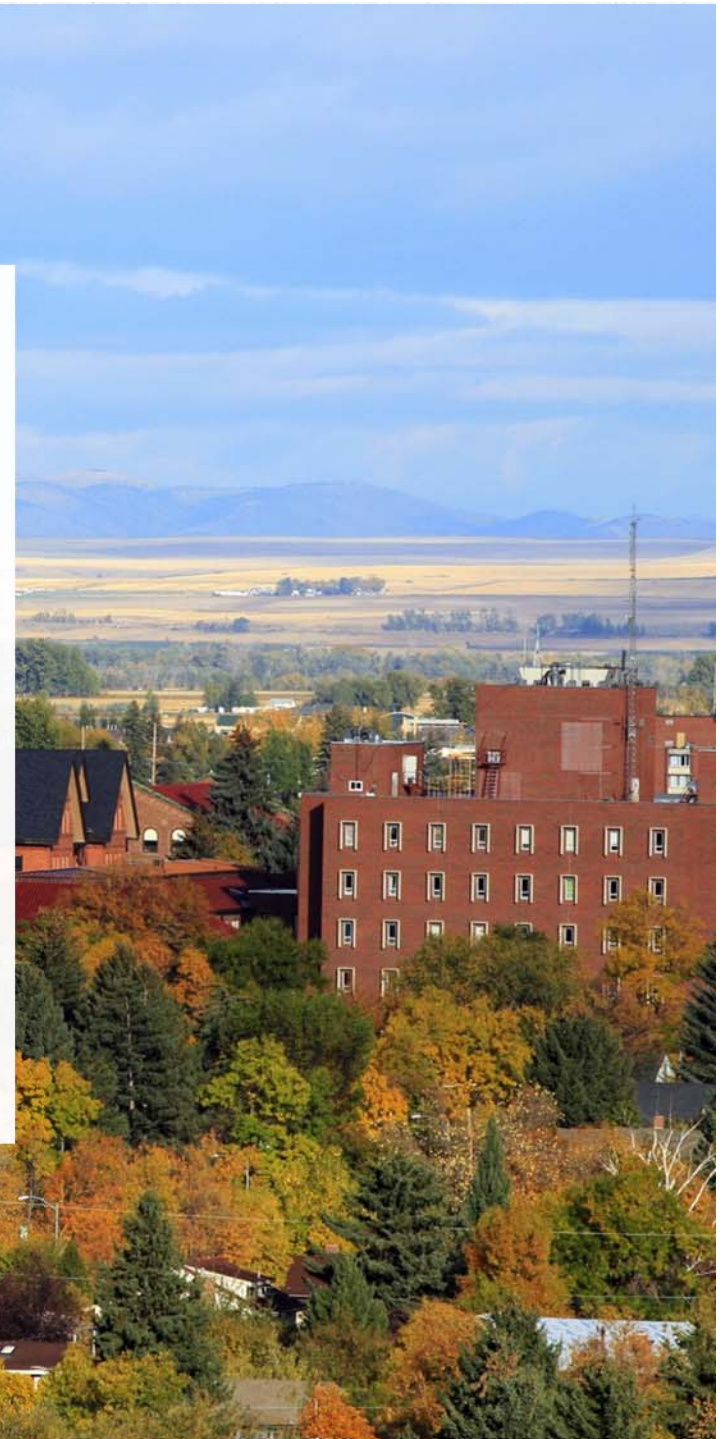


COMPREHENSIVE CARBON PLAN FOR ARIZONA STATE UNIVERSITY

ROY TORBERT
IDEA CONFERENCE
FEBRUARY 12TH 2015

RMI. Creating a clean, prosperous,
and secure energy future.™



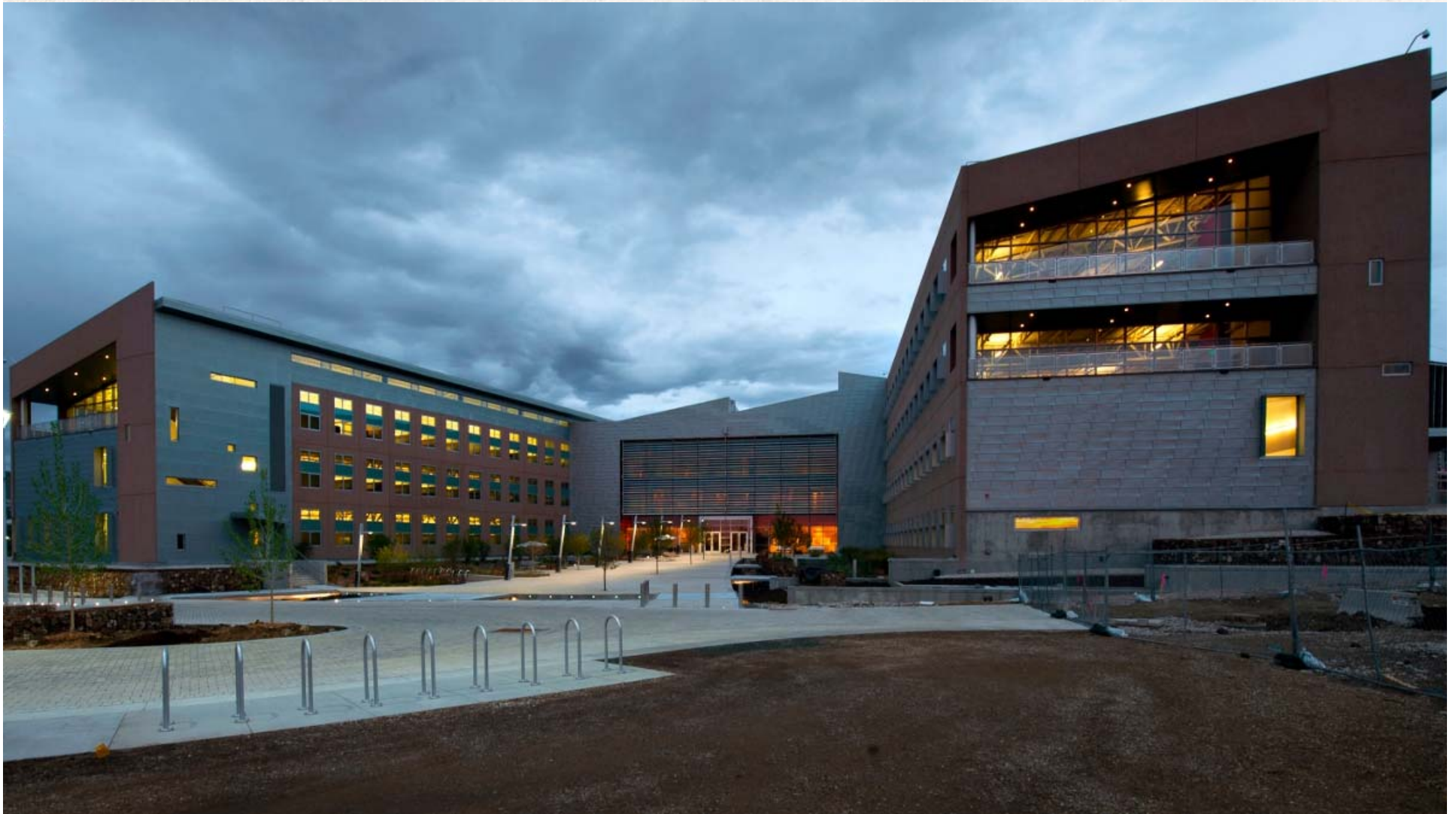
PEOPLE SEEING THE BEAUTY OF THIS VALLEY WILL WANT TO STAY
THEIR STAYING WILL BE THE UNDOING OF THE BEAUTY.







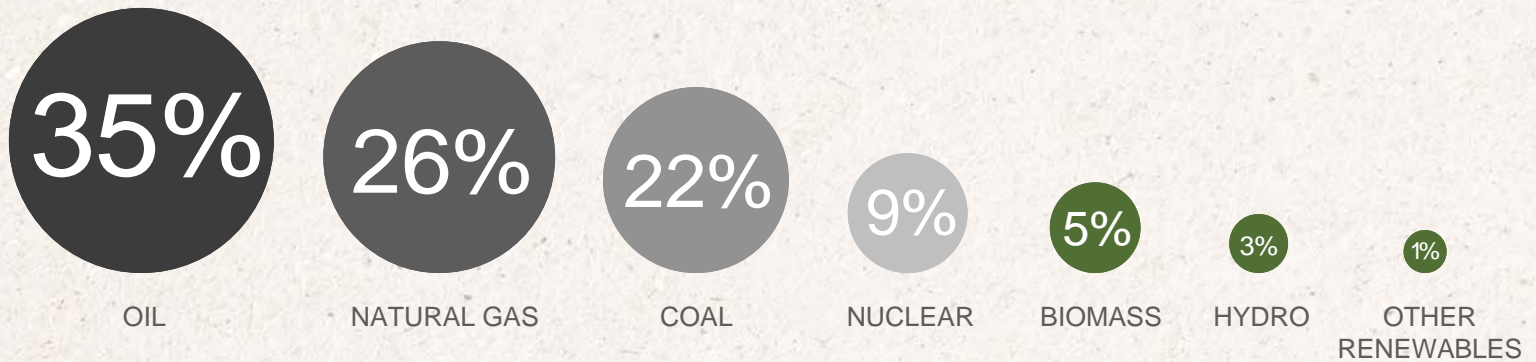
CURRENT NET ZERO BUILDINGS



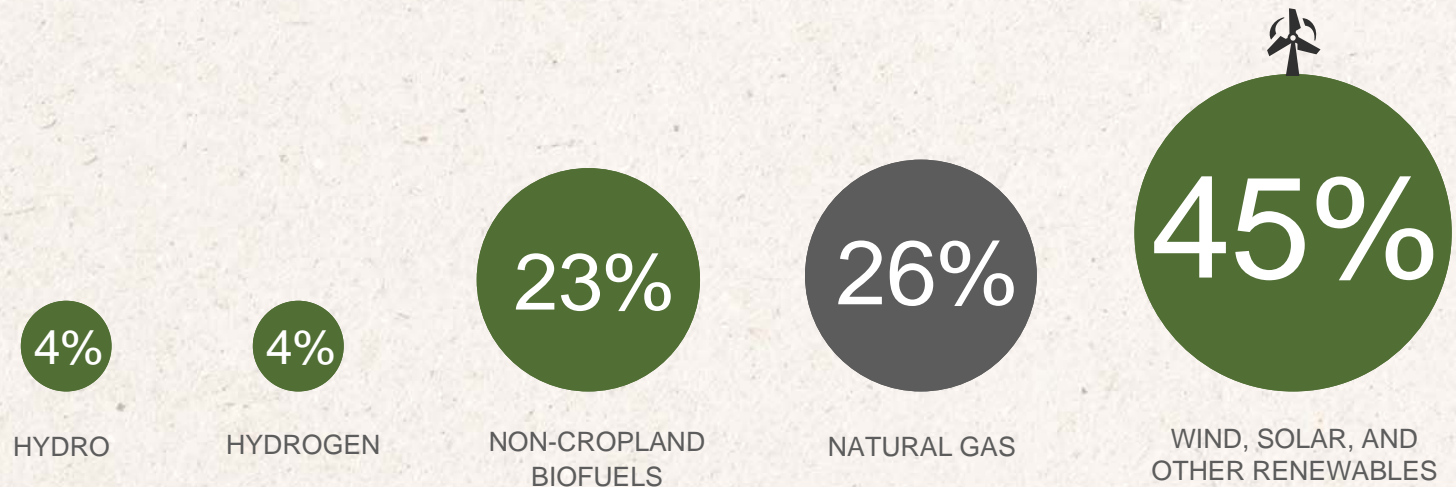


REINVENTING FIRE: U.S.

TODAY



2050



arizona state university

AMERESCO



ROCKY
MOUNTAIN
INSTITUTE®

carbon neutrality action plan

in 2025,
ASU will
be **carbon**
neutral.*

Submitted September 15, 2009
Updated January 2010



RIGHT STEPS IN THE RIGHT ORDER

1. Define University Needs & Set Big Fat Audacious Goals

2. Involve Entire Campus Community

3. Understand Existing Assets, BAU, Planning Docs

4. Measure Baselines and Establish Monitoring System

5. Reduce Loads – Energy, Water, Waste (comprehensive)

6. Select Appropriate & Efficient Technologies

7. Seek Synergies Between Systems and Departments

8. Optimize Controls and Engage Users

9. Integrate Renewables

10. Realize & Maintain Intended Design, Track VBECS

**Most people
start here!**



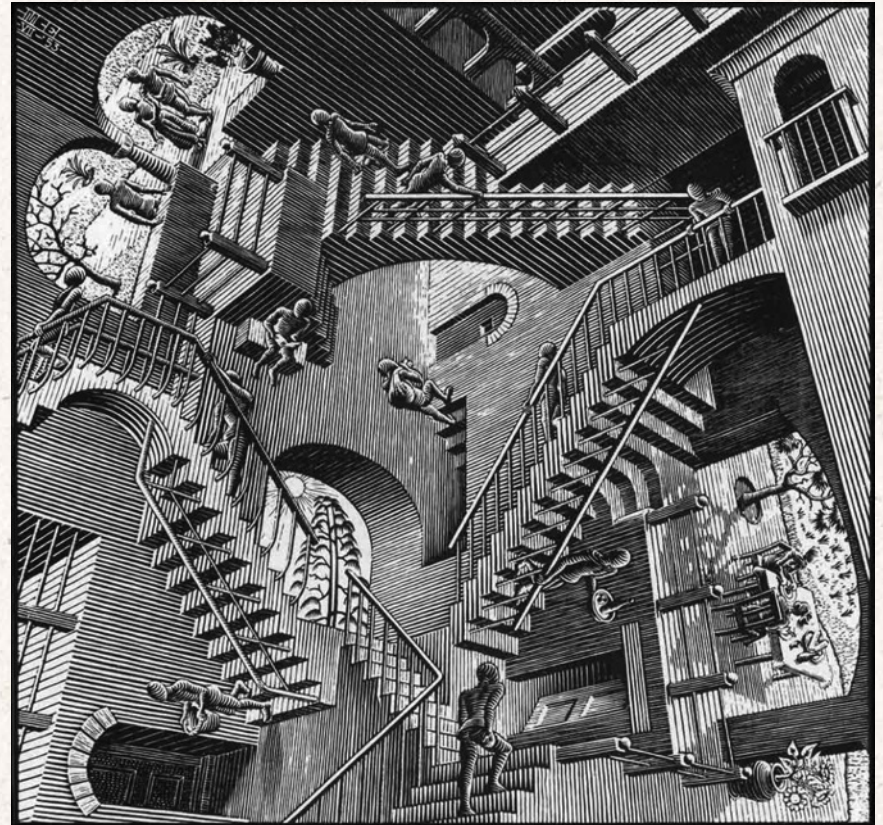
OUR CHALLENGE

We are building the new Climate Neutrality model under the rules and paradigms of the old model.

Examples of Current Paradigm Rules that Constrain Necessary Change:

- Short-Term vs. Long-Term Focus
- First Cost vs. Life Cycle Cost
- Traditional vs. Sustainability Metrics
- “LEED Silver” Design Guidelines
- Utility Regulations

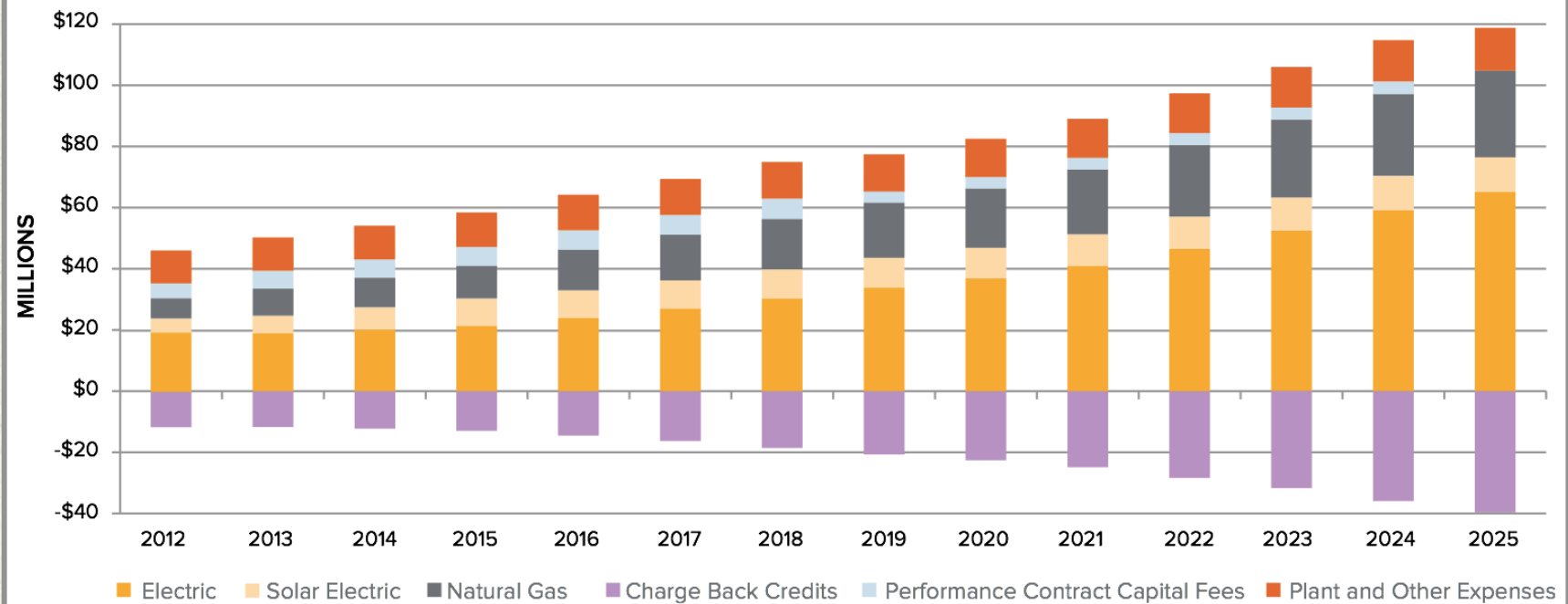
If you change one thing, then all things must be changed, or at least be re-examined.



ASU ENERGY USE FORECAST

BAU FORECAST OF ASU ENERGY COSTS

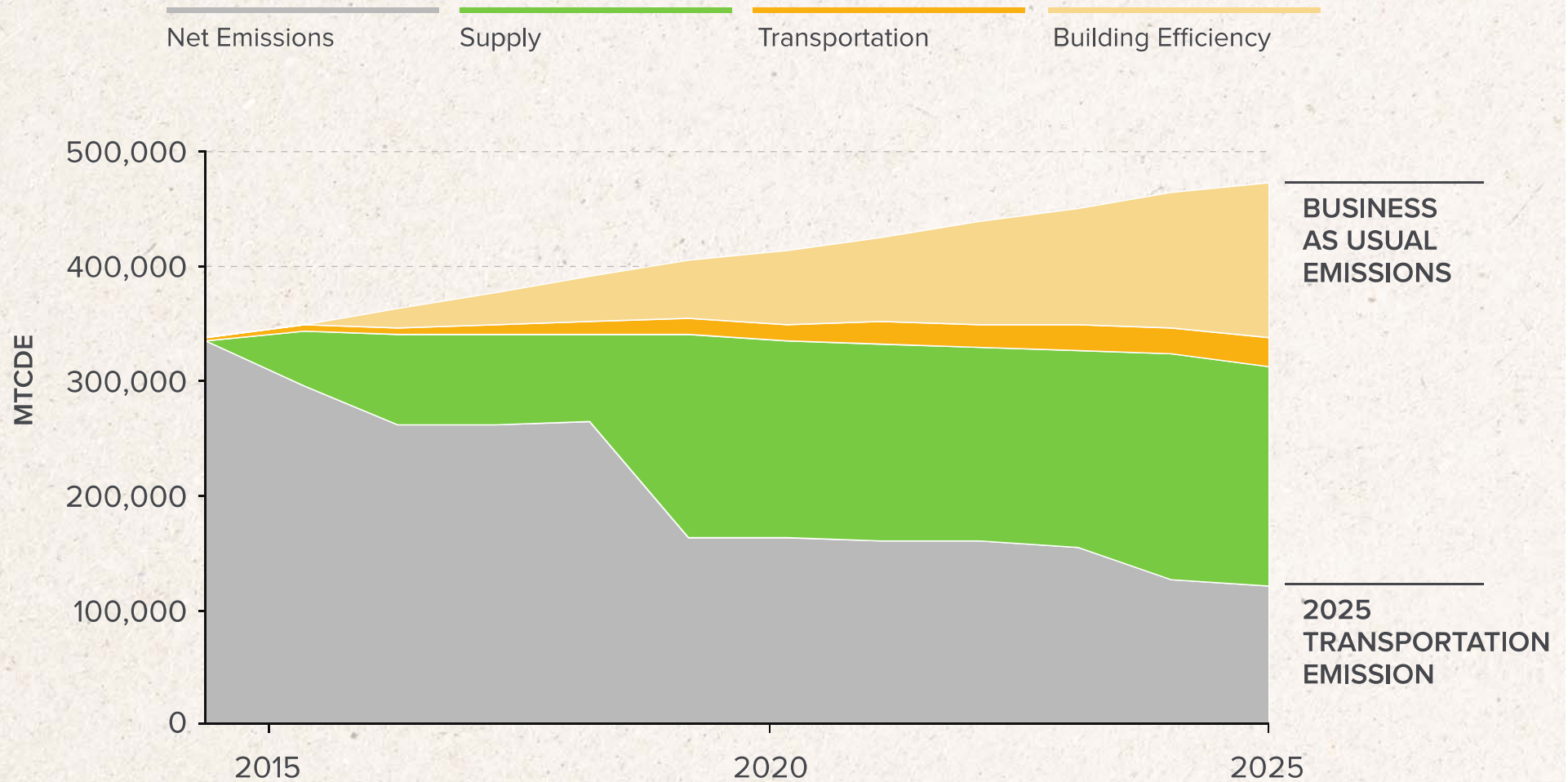
FIGURE 12



NOTE: Future energy use is modeled as a function of people (students, faculty, and staff) and total square footage.
Future energy prices are based upon EIA regional forecasts.

ASU will spend roughly \$570 million in total energy costs by 2025

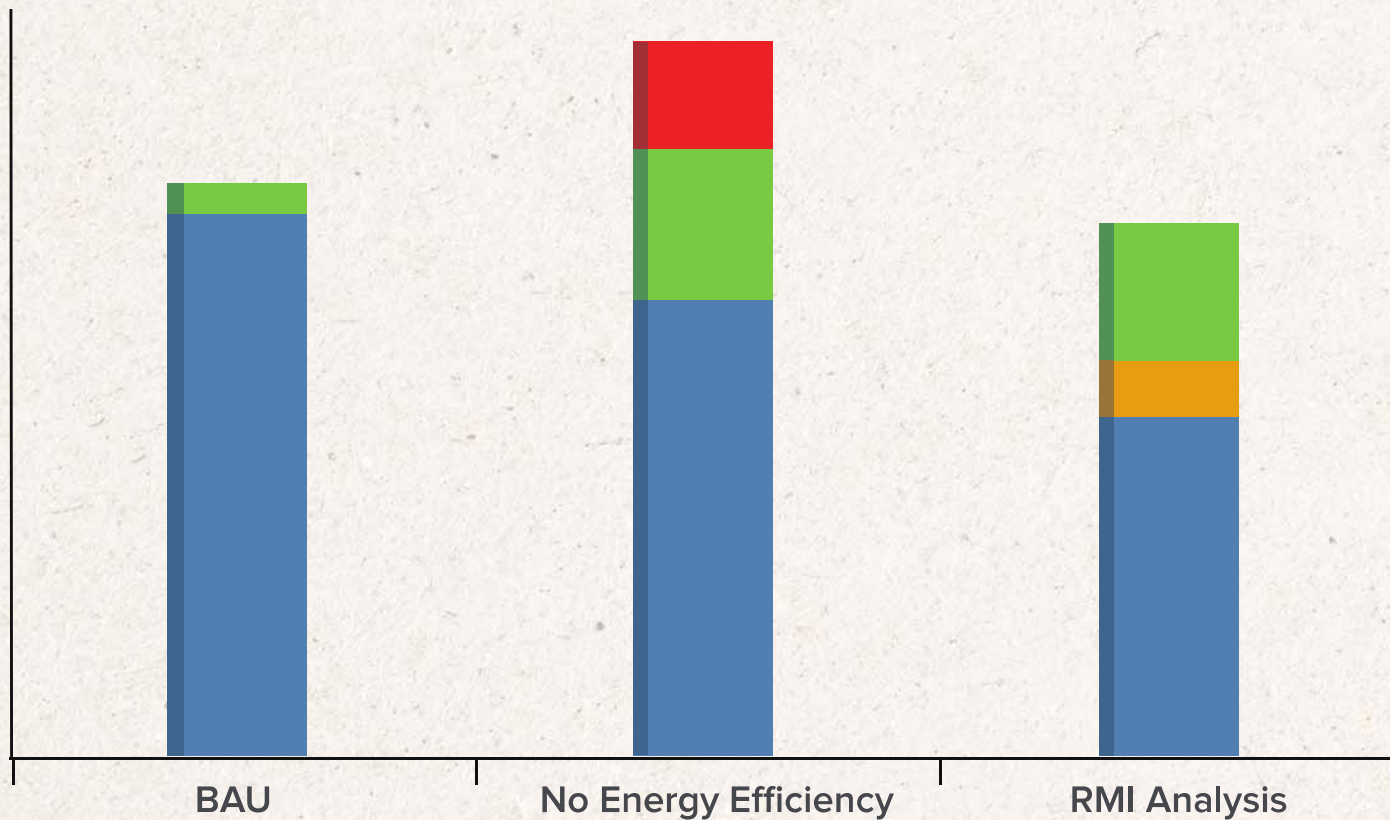
RMI ANALYSIS ON CARBON NEUTRALITY



NET PRESENT COST ANALYSIS: CARBON NEUTRALITY AT SAME COST

2025 NET PRESENT COST COMPARISON

● Utilities & Plant Operations ● Energy Efficiency ● Solar & Wind ● Biomass



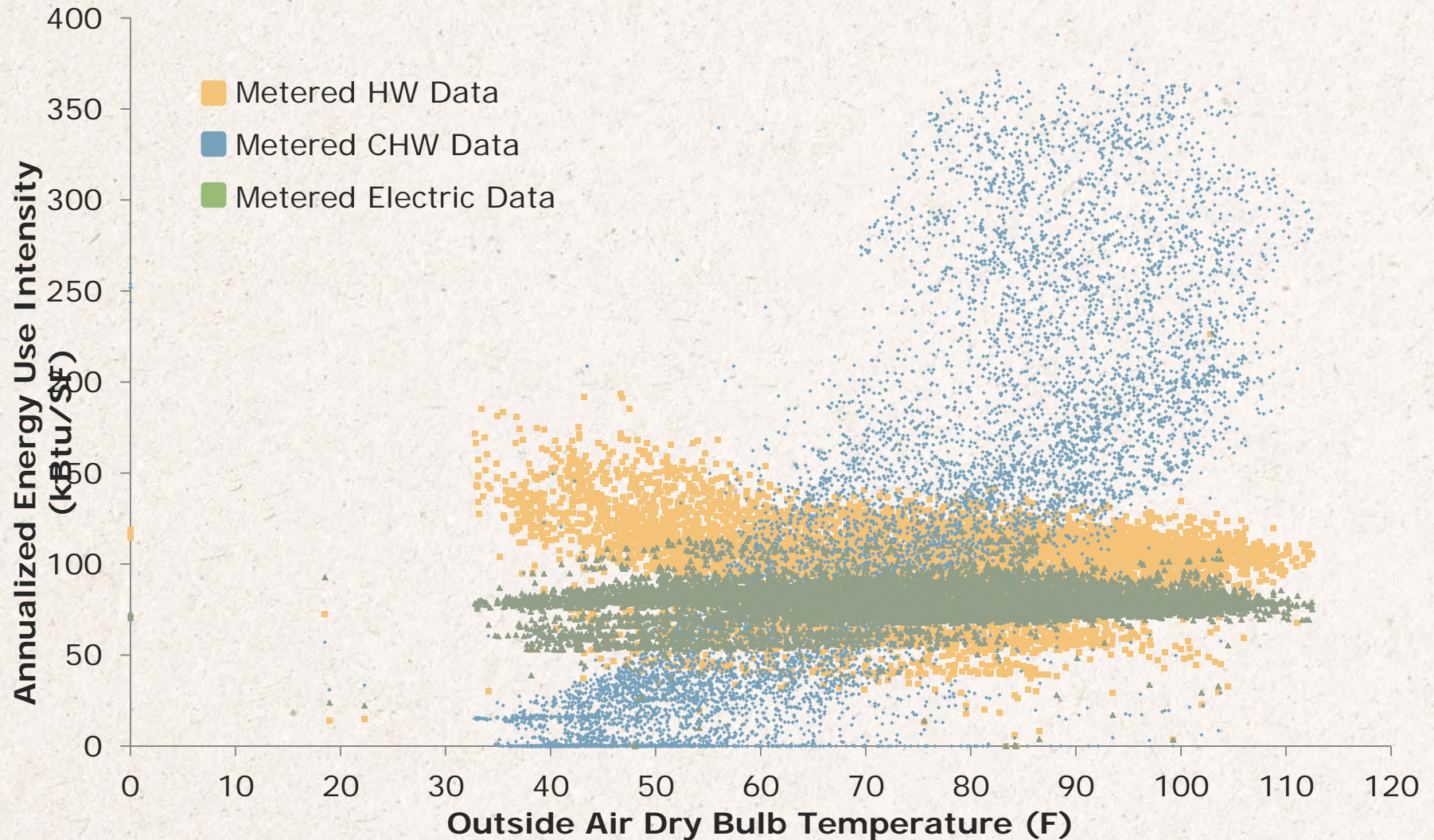
HOW DID WE GET HERE?

“YOU NEVER CHANGE THINGS BY FIGHTING THE EXISTING REALITY. TO CHANGE SOMETHING, BUILD A NEW MODEL THAT MAKES THE EXISTING MODEL OBSOLETE.”

- BUCKMINSTER FULLER

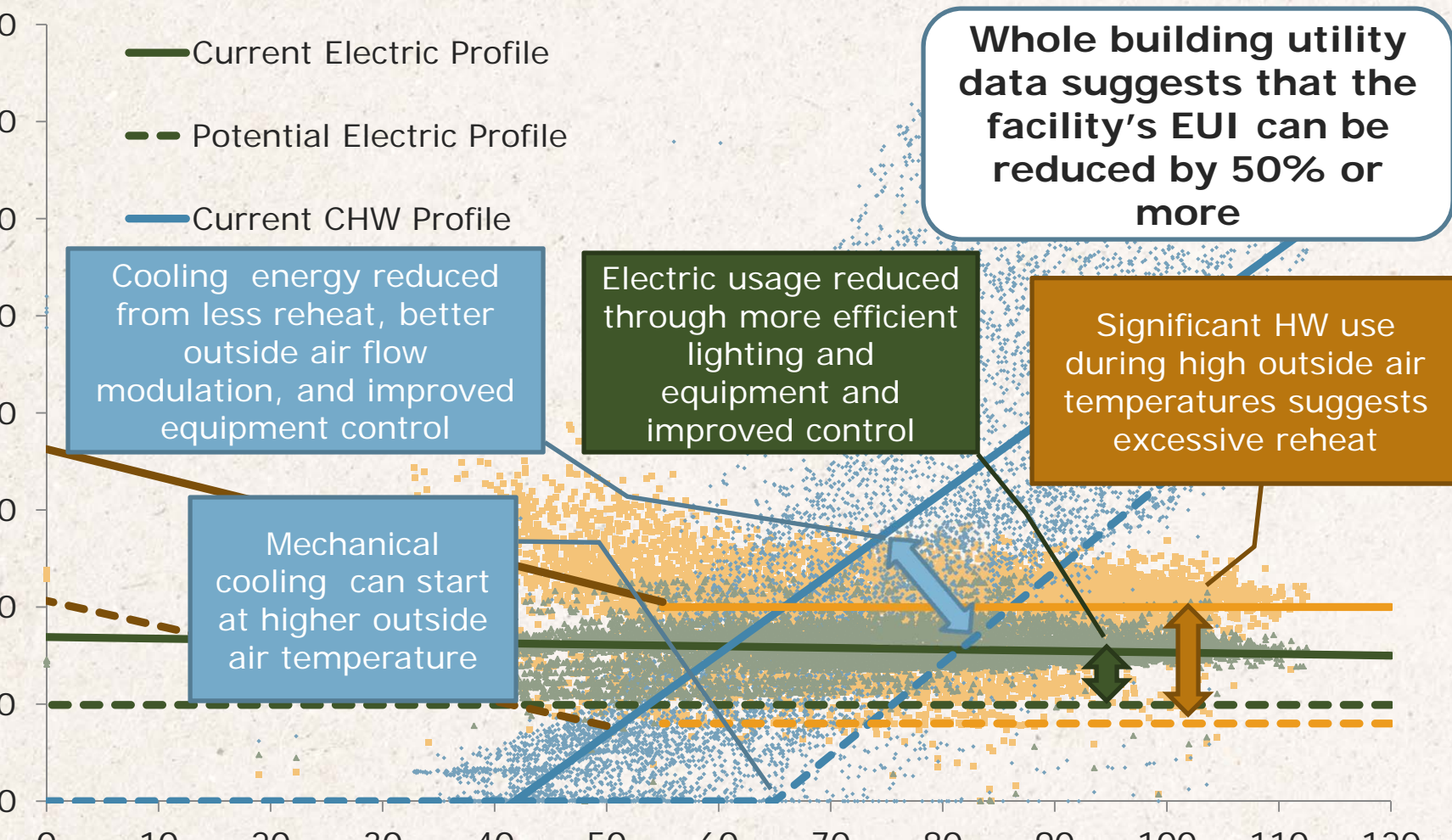
BUILDINGS: IDENTIFYING ENERGY REDUCTION OPPORTUNITIES

Empirical Data: Large University Research Building (30% lab/70% classroom)



BUILDINGS: IDENTIFYING ENERGY REDUCTION OPPORTUNITIES

Empirical Data: Large University Research Building (30% lab/70% classroom)



CENTRAL PLANT – UNCOVERING INEFFICIENCIES

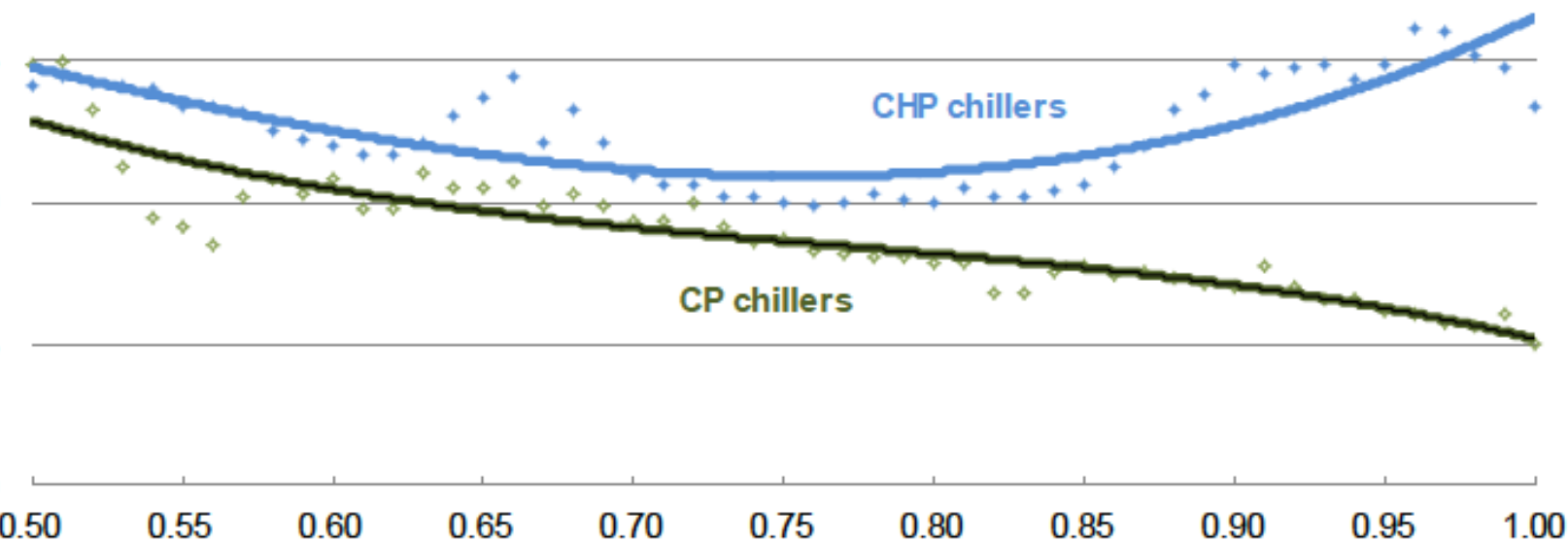
Chiller Unloading, CP and CHP, v % Full Load

averaged over interval, not instantaneous

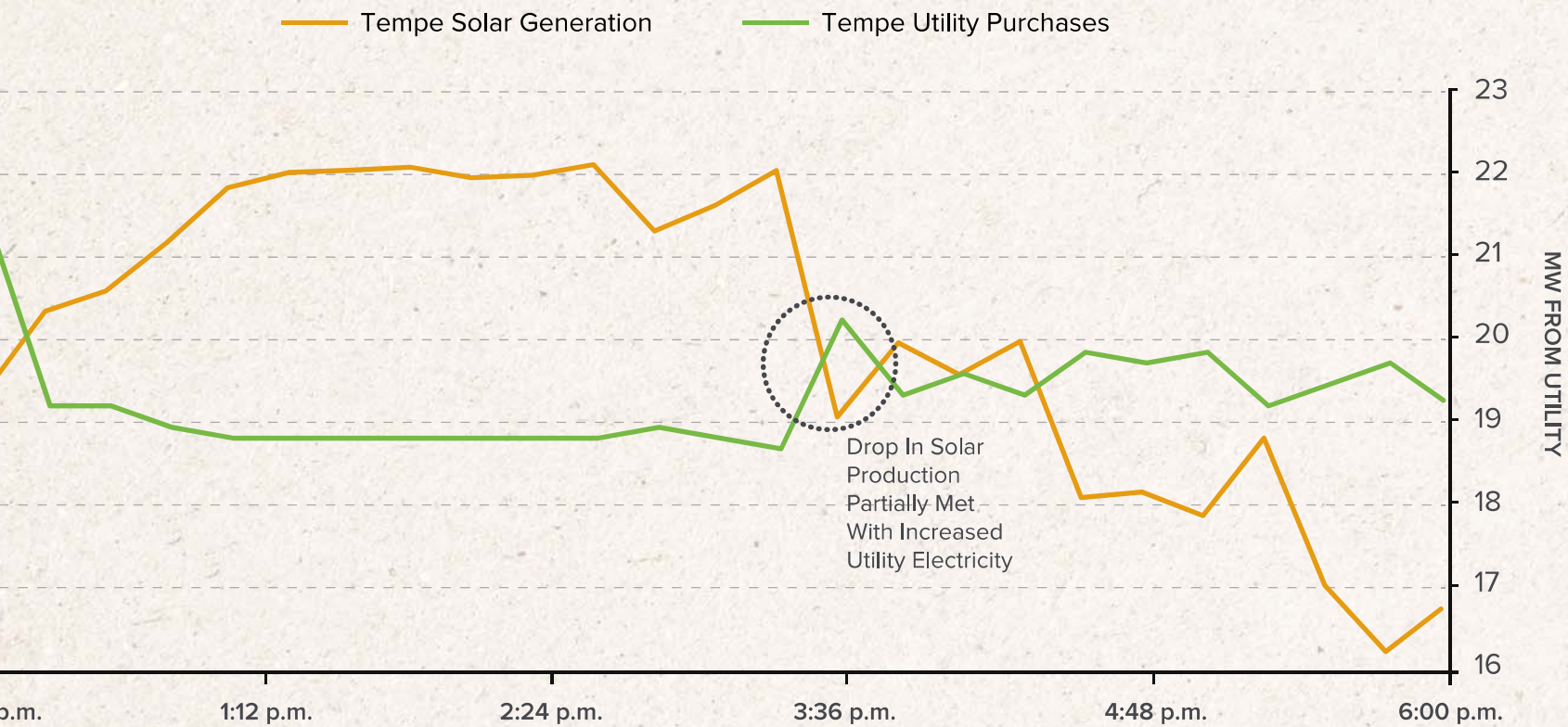
ton

8760 total samples, 1 hour intervals, Sep 2012 - Aug 2013

there are still 8,760 samples, but they are "compressed" because the kW/ton is averaged for each 0.01 of full load. So there are only 50 data points shown for each curve (1.00 to 0.50) but each one can represent many actual data points that fall into that 0.1 percent range

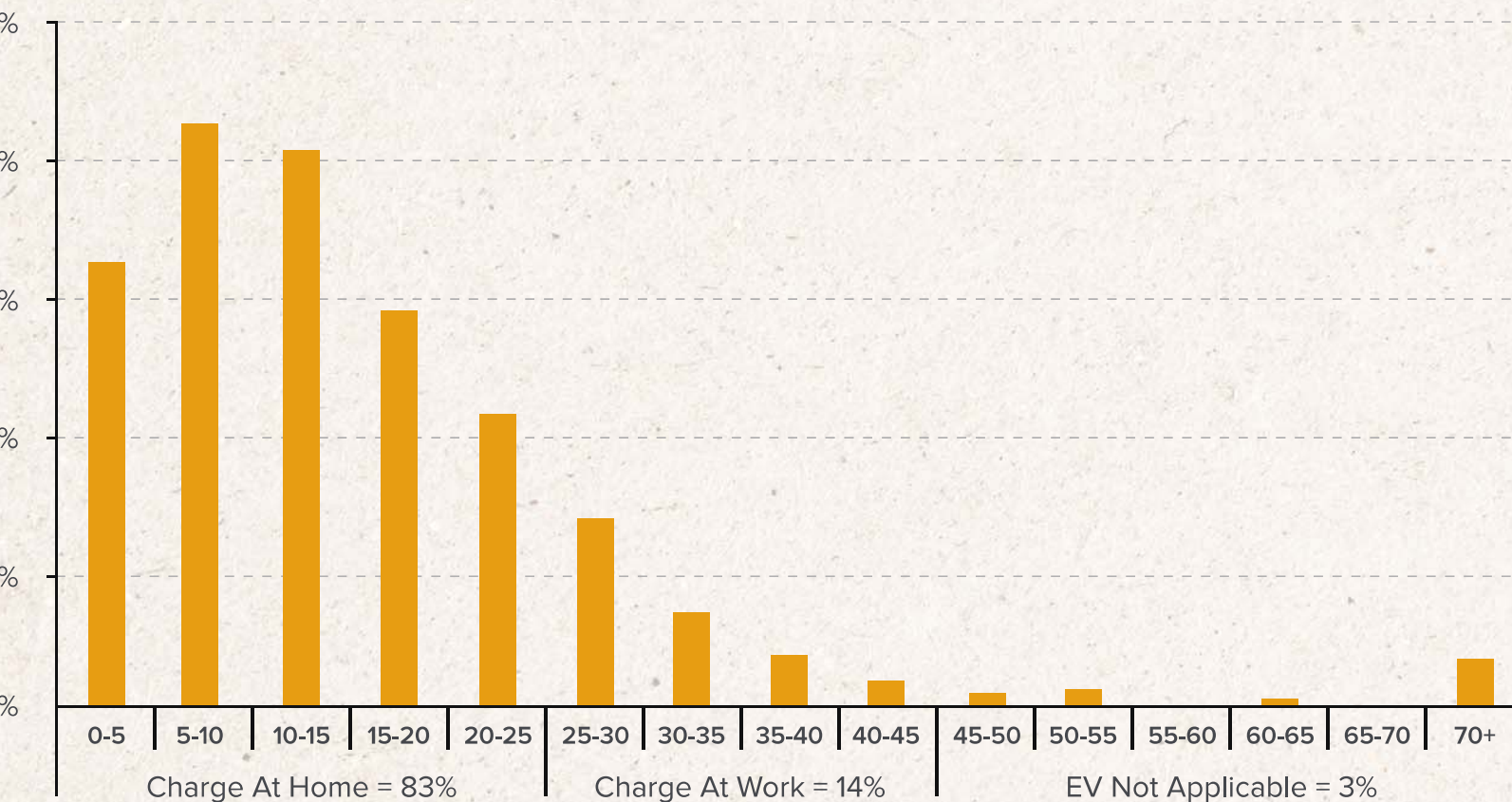


RENEWABLE SUPPLY: EXAMINED ON-SITE SOLAR PRODUCTION



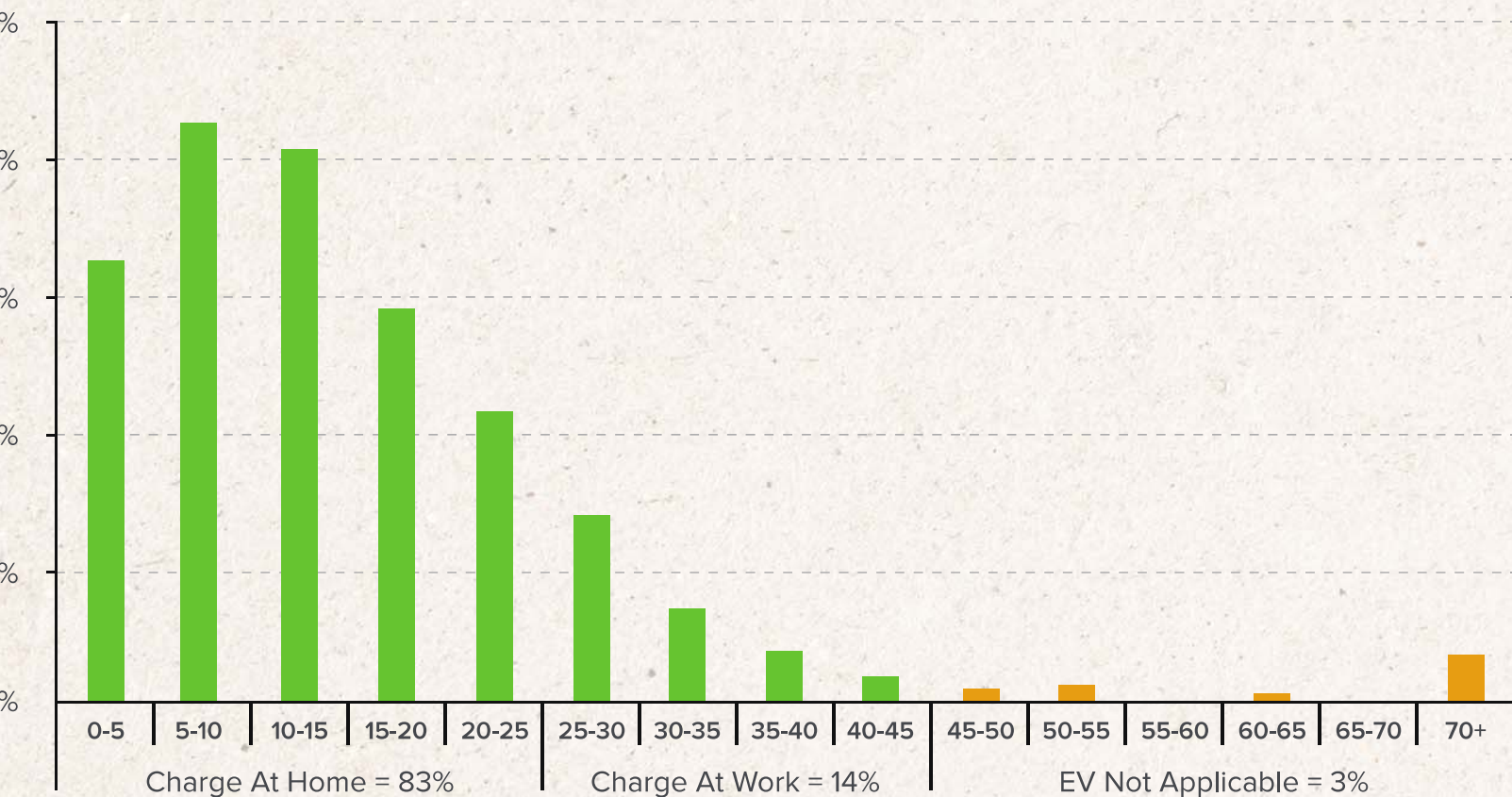
TRANSPORTATION: POTENTIAL FOR EV ADOPTION & ON-CAMPUS CHARGING

ASU FACULTY & STAFF COMMUTING DISTANCES: POTENTIAL FOR EV ADOPTION & CHARGING BEHAVIOR



TRANSPORTATION: POTENTIAL FOR EV ADOPTION & ON-CAMPUS CHARGING

ASU FACULTY & STAFF COMMUTING DISTANCES: POTENTIAL FOR EV ADOPTION & CHARGING BEHAVIOR



MI CAMPUS VISION

College and universities...

Account for **5%** of U.S. commercial building sector emissions

Are ideal **proving grounds** for **innovative approaches**;

Are **educating future** political, business and social **leaders**, providing a powerful vehicle for changing behavioral and societal norms;

25 Campus Goals

Help **100+** large universities reduce carbon emissions by 50%

Inspire 600 more colleges and universities and over 10 million students, faculty, and staff to cut their carbon footprints

“IF SOCIETY DOESN'T KNOW HOW TO DO SOMETHING, UNIVERSITIES ARE WHERE YOU GO TO SOLVE THOSE PROBLEMS.”





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and secure energy future™