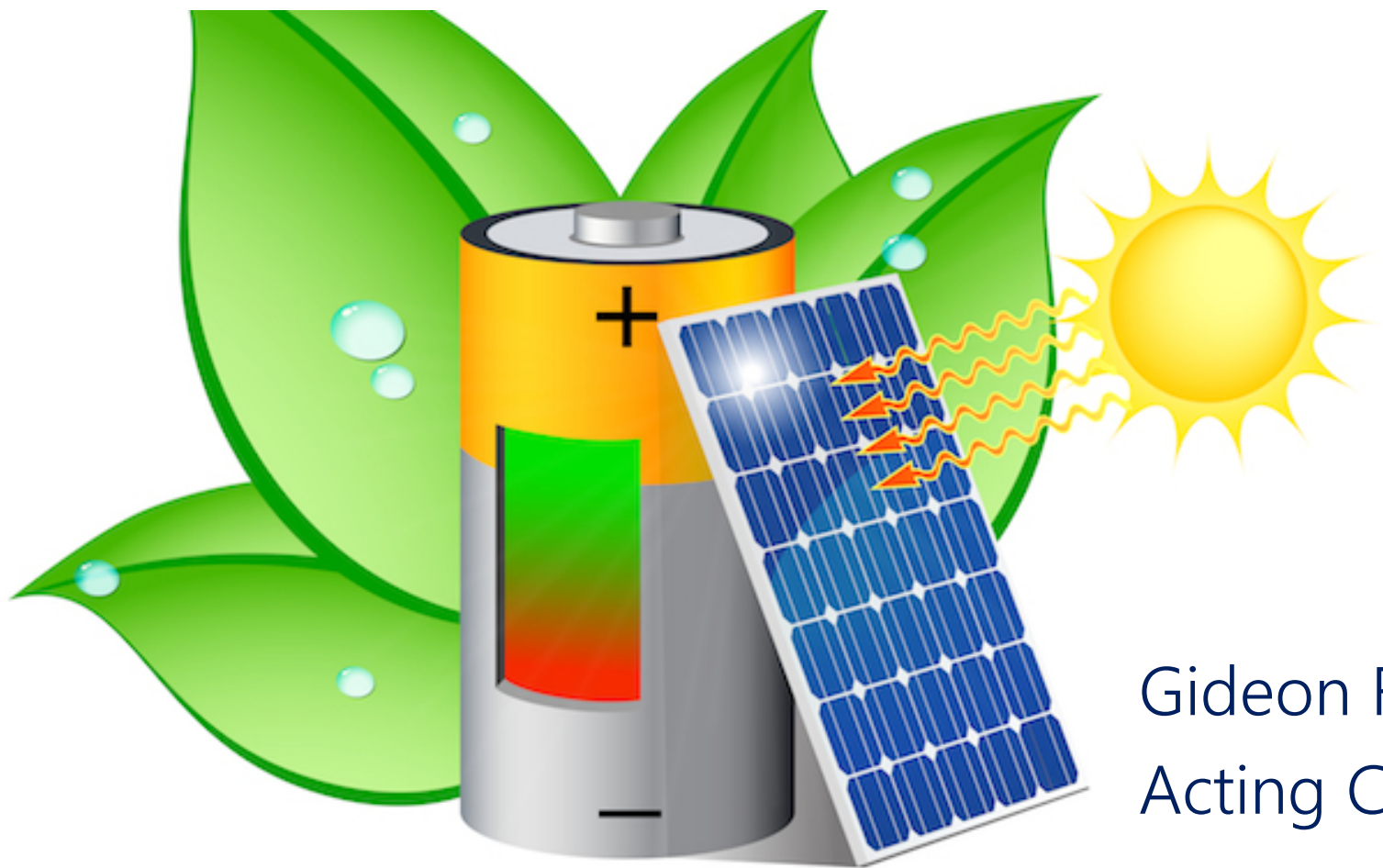


PV + Storage – A New RE Source



Gideon Friedmann, Ph.D.
Acting Chief Scientist

פעילות משרד האנרגיה

- (קול קורא הזנק)
- קול קורא חלוץ (הגשה בתחילת יולי)
- RFI מתקני אגירה עם אנרגיה מתחדשת וניהול
- קמפוסים, קיבוצים, שכונות, מתקני תשתית, מבנים גדולים
- חרום (למשל מקלטים ציבוריים)
- שימוש במערכות סולאריות בזמן נפילת הרשת
- שילוב כלי רכב חשמליים + סוללות של רכבים ישנים
- ניהול ביקושים (תדר, הסטה) באמצעות אגירה
- RFI לפיתוח מפה אינטראקטיבית לעמדות טעינה לרכבים

Advantages of Renewable Energy

- Energy Security and Diversity
- Emissions Reduction
- Electricity at Operating Cost at the end of the period
- Price stability
- Educational / PR Value Sustainability



Issues w Renewable Energy

- Intermittency
- Need for Backup
 - In Germany, daily Min vs. daily Max in a year: 30 Vs 530 GWh
 - Sequence of low production days
 - Summer – Winter imbalance (at least 50%)
- Costs (Less so today)
 - Cost of electricity in Germany doubled
 - Cost is upfront
 - Transmission Grid upgrade

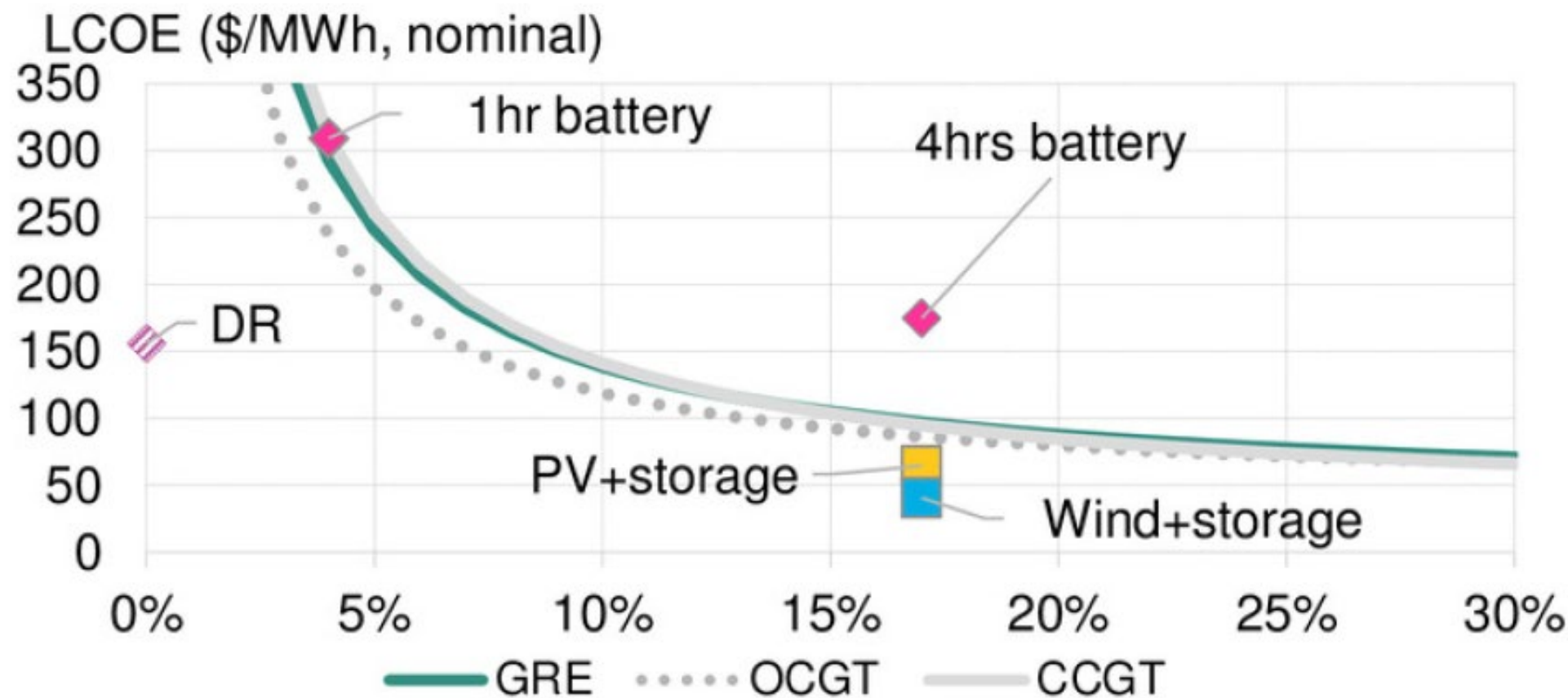
What do we need?

- Other renewable sources (geothermal, salt concentration, fusion)
- Higher efficiency solar / secondary land use / Land
- Storage
 - Fuels production (electrolysis, photon based, etc)
 - Carbon Capture (?)
 - Efficient power generation from fuels

Why is PV + Storage a Game Changer

- PV is non dispatchable
 - Intermittent
 - Sharp Ramp on / Ramp off
 - Not at the best time
- Storage needs a power source
 - Pumped hydro runs on coal ?
- PV + Storage is a new RE source !
- Local production opens the door to new applications

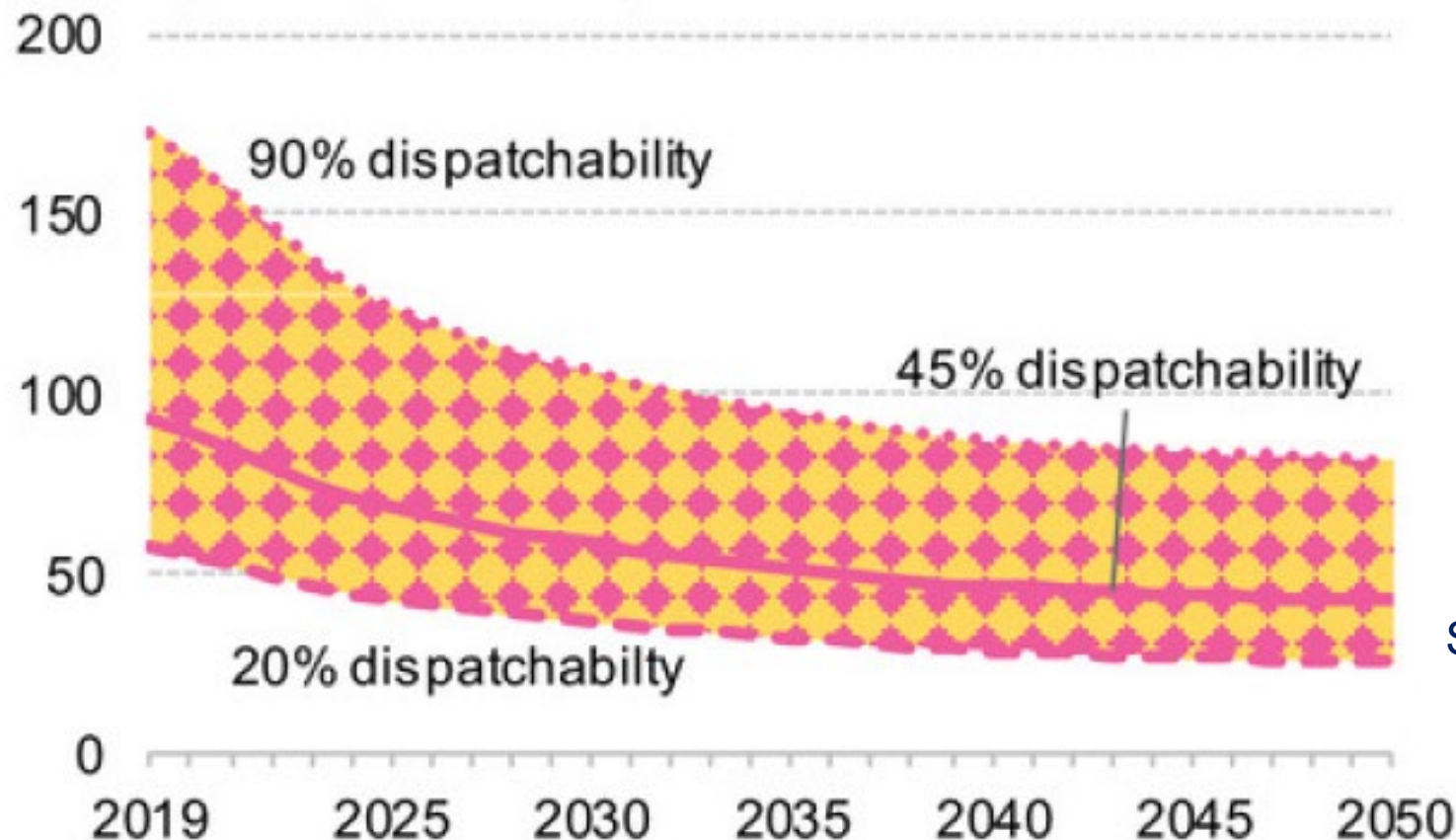
Gas Peaker Vs Batteries



Source BNEF

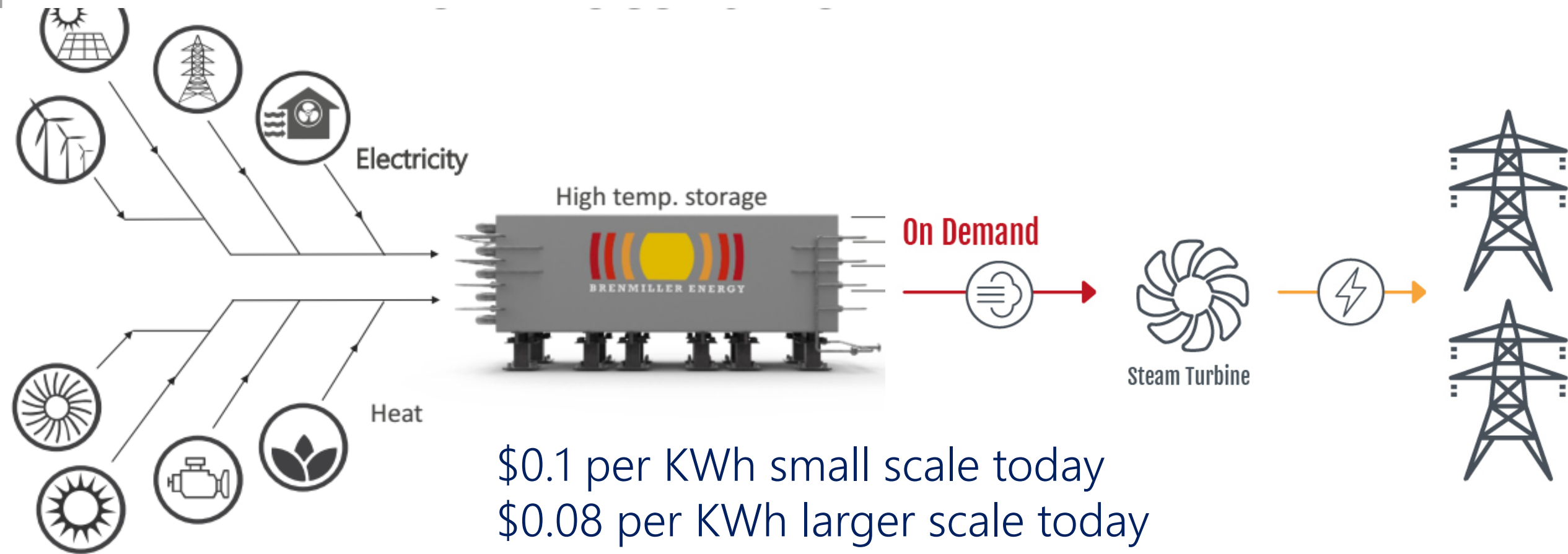
Cost of PV + Storage

LCOE (\$/MWh, 2018 real)



Source BNEF

85% Renewables today ?



\$0.1 per KWh small scale today
\$0.08 per KWh larger scale today
\$0.06 per KWh in a few years

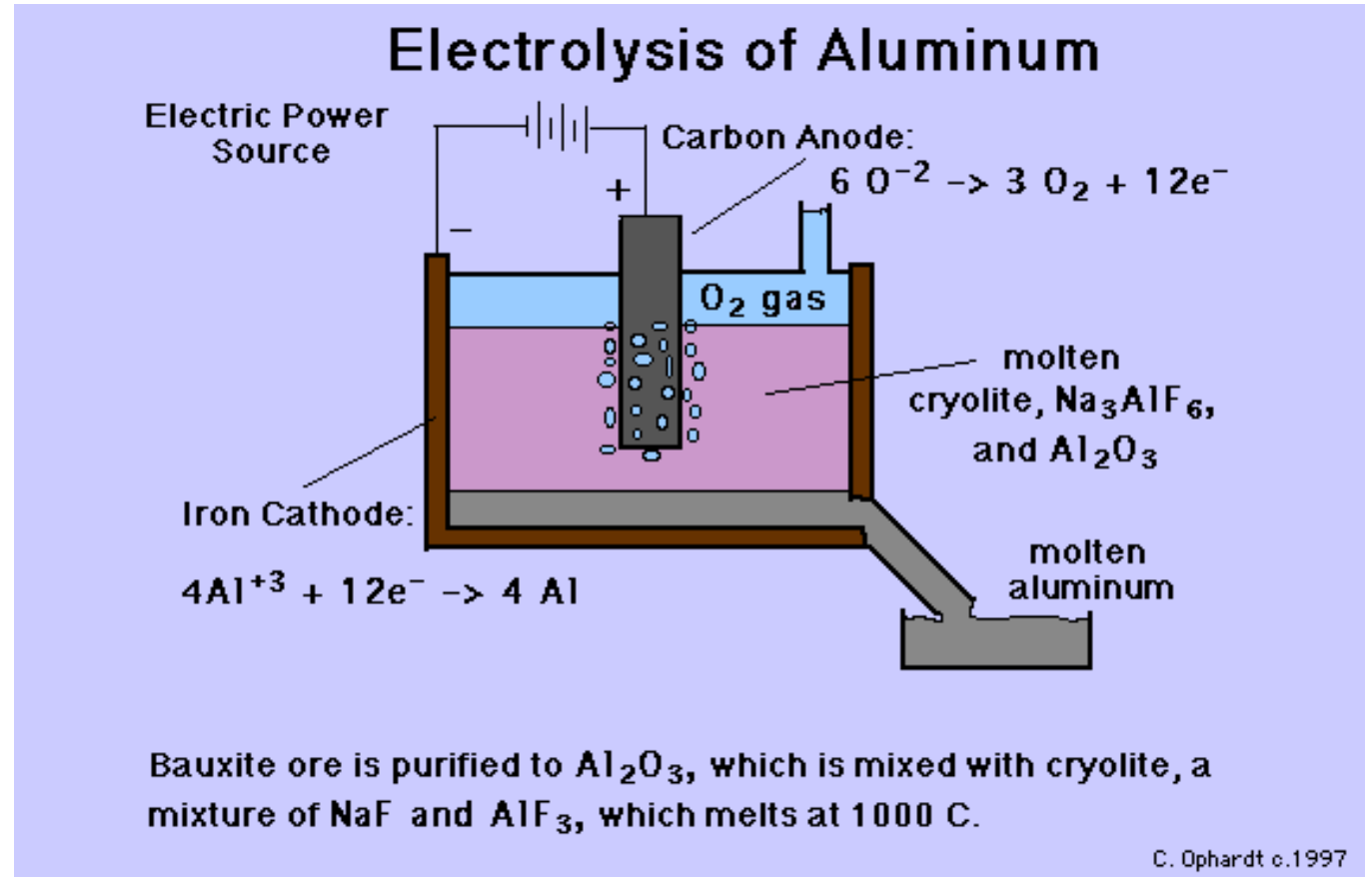
PV + Desalination

- Power is 25%-30% of water cost
- Local PV can reduce costs by 10%-20%
- Water can be stored & supplied as needed

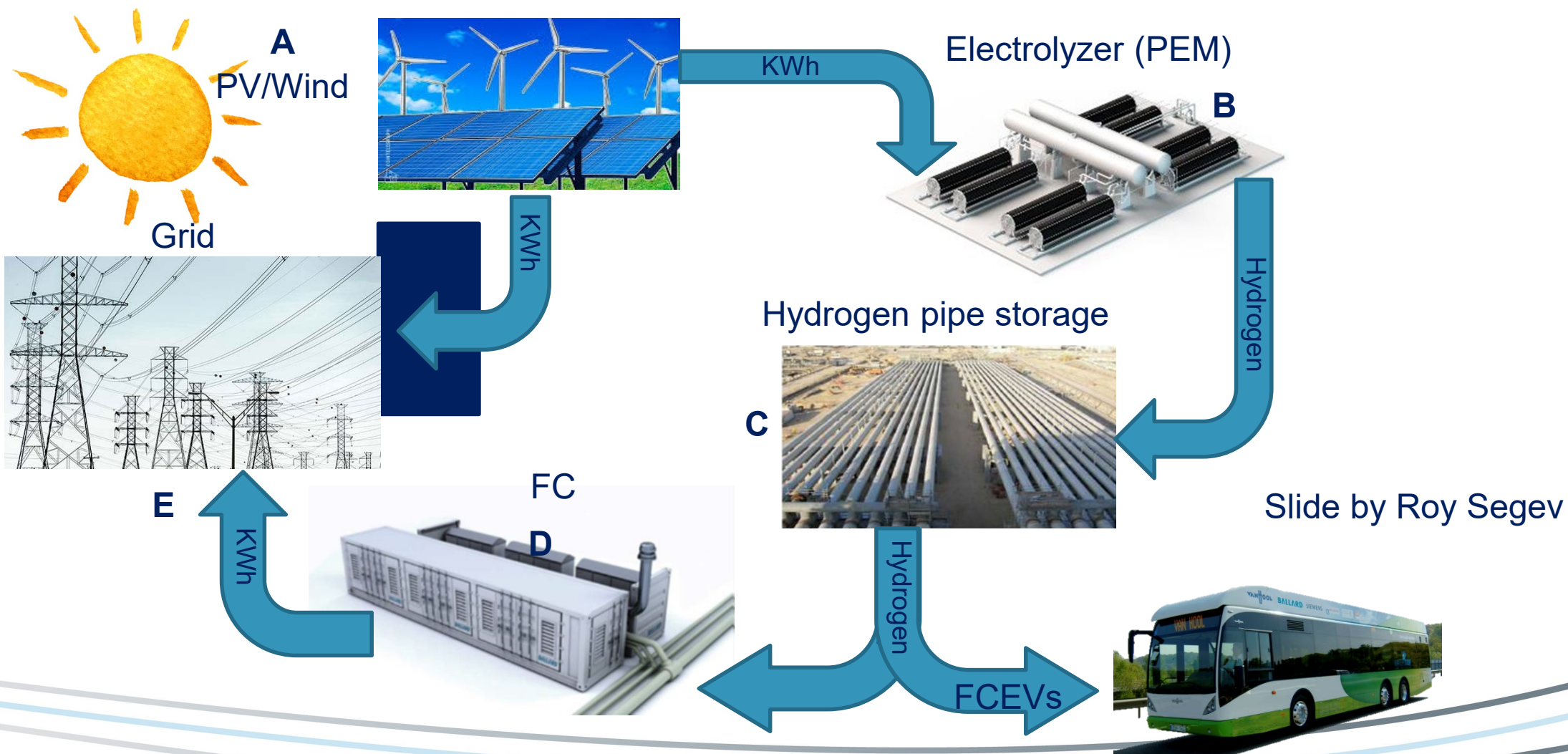


PV + Smelting

- Can we use PV for heat?
- 1 MMBTU=293 KWh
- Gas costs \$5 / MMBTU ↔
1 KWh heat = 0.06 shekel
1 KWh heat (PV) = 0.085 S

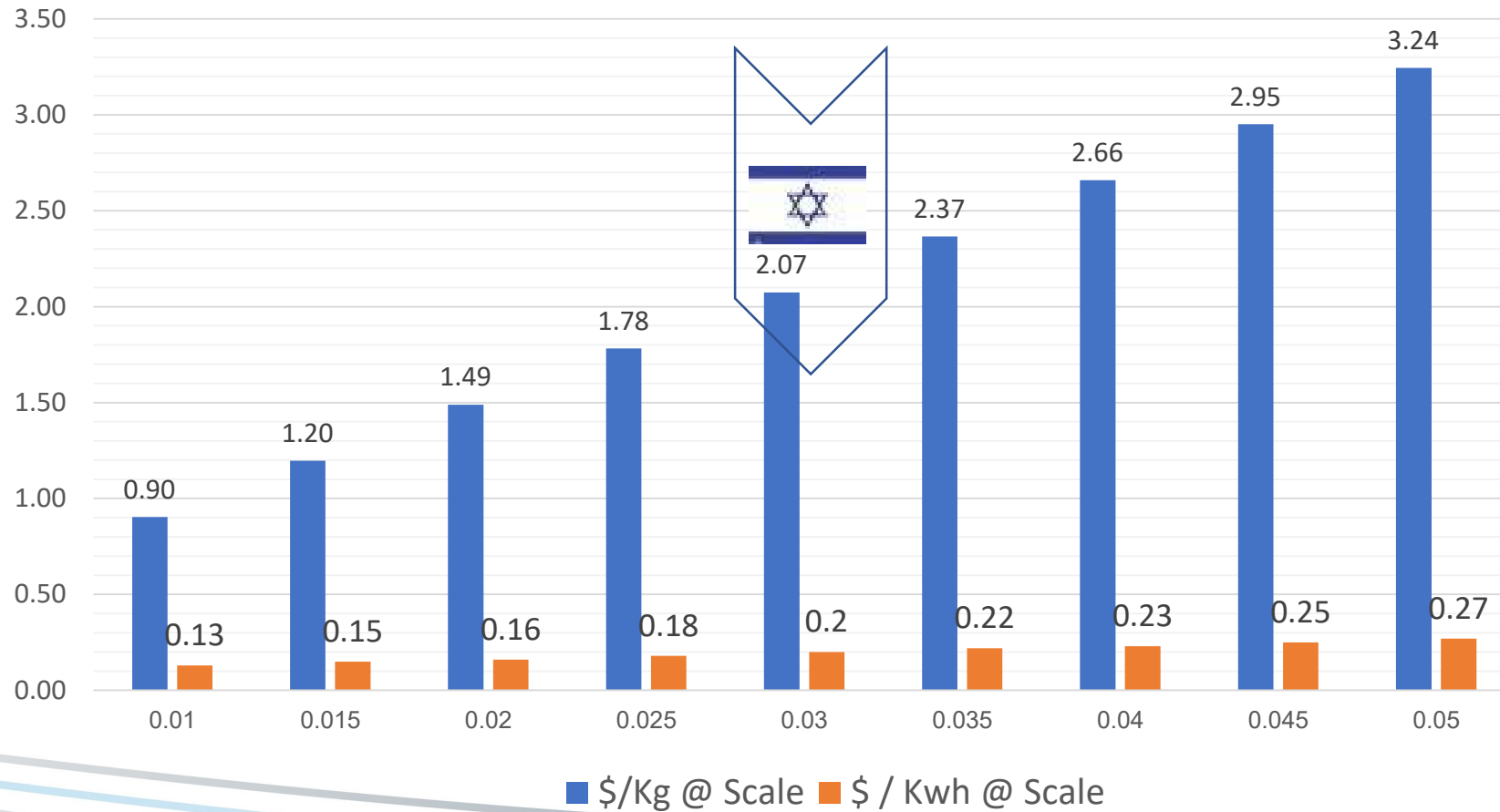


Hydrogen Cycle



Hydrogen Cost

Cost of Kg of H₂ (blue) and Kwh by PEM FC (orange)
as function of Kwh cost from PV , Wind or Grid



Slide by Roy Segev

Storage & Renewables

- Storage is a must for significant penetration of renewables
- Li-Ion industrialization projections look very positive
Current cost of PV+Storage \$0.1-0.15 /KWh
- Competition between batteries and hydrogen
Current costs of PV+Hydrogen Storage \$0.15-0.25 /KWh
- Competition w heat
Current costs of PV+Heat Storage \$0.08-0.1 / KWh (e)
- Long term storage must use fuels

gideonf@energy.gov.il

