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Considerations for Applying Renewable Energy to Environmental Remedies

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Renewable Energy and Site Remediation

- Use of renewable energy can help lower the environmental energy and emissions footprints of a remedy
- Can apply renewable energy in several different ways
  - On-site generation of electricity from renewable resources (e.g., on-site solar, wind)
  - Use of fuels from renewable resources (e.g., biodiesel, landfill gas)
  - Purchase off-site renewable electricity
  - Use of materials/chemicals manufactured with renewable energy

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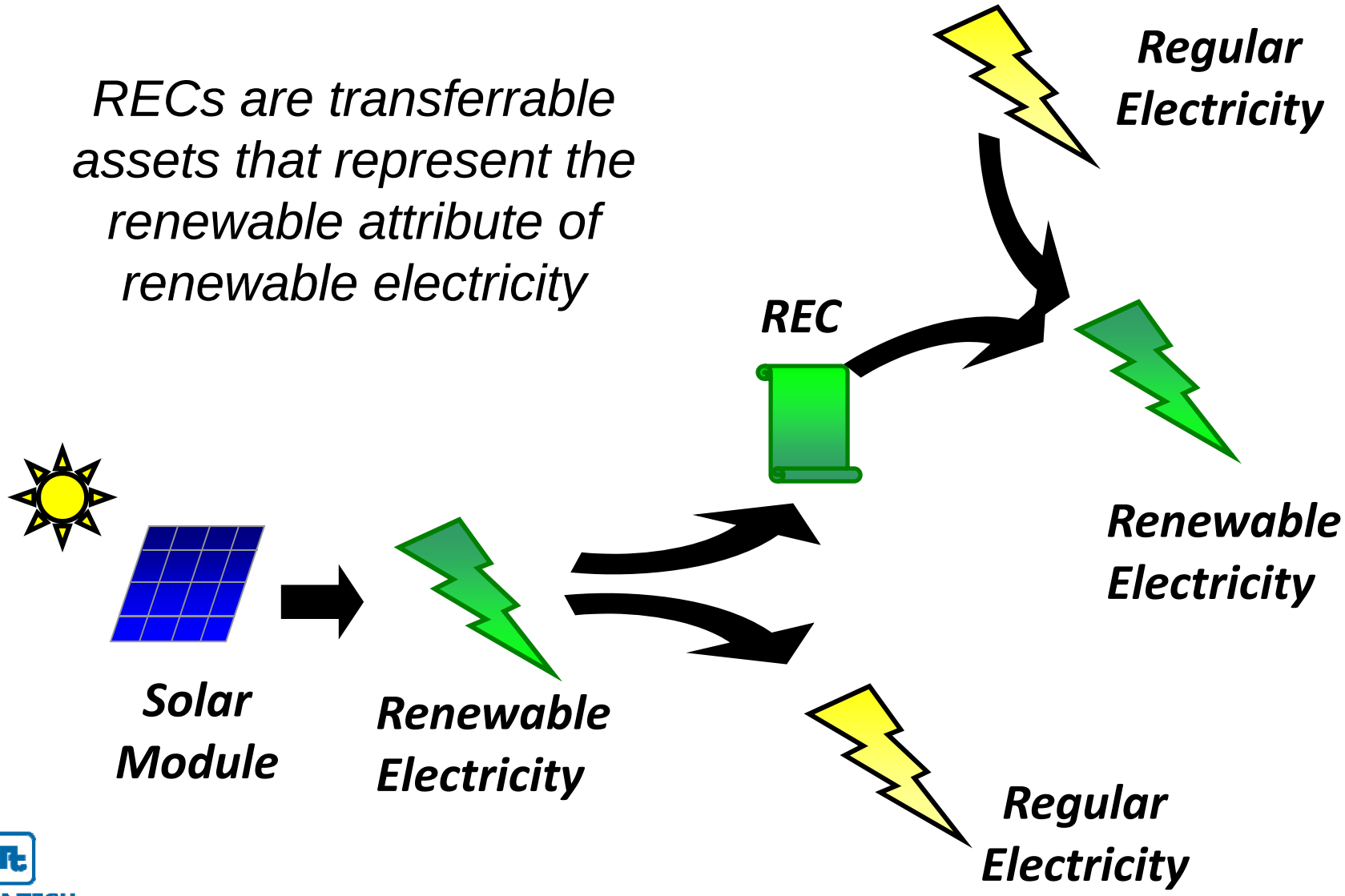
How do You Purchase Renewable Electricity?

- Option 1 – Purchase additional renewable electricity from through your electric utility
  - Green pricing
  - Selecting a green power provider

- Option 2 – Purchase Renewable Energy Certificates (RECs)

Renewable Energy Certificates (RECs)

RECs are transferrable assets that represent the renewable attribute of renewable electricity



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A Few Rules

- *For REC purchasers…*
  - *"RECs combined with plain grid electricity are functionally equivalent to green power purchases from a local utility, no matter where the REC may be sourced." – EPA Climate Leaders*
- For REC generators…
  - *"In order to claim the zero greenhouse gas emissions from electricity generated on-site, the RECs would need to be retired and not sold to a third party." – EPA Climate Leaders*
- In general, RECs should only be used to offset conventional electricity use and associated emissions (NOT emissions from natural gas, diesel, or gasoline usage, etc.)

Implications

- Many renewable energy incentives require the sale of your RECs

Many on-site renewable projects are not financially viable without these incentives

Read the description of the incentives carefully!!!

- Purchased renewable electricity is likely more cost-effective than on-site renewable electricity generation in many situations

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Implications Continued

- We can optimize where renewable electricity generation facilities are constructed.

What is a better use of resources?

An on-site wind farm in an area with a poor wind resource or purchasing RECs from a high performance wind area?

- The ability to purchase RECs puts a price tag on green remediation for electricity intensive remedies.

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Hypothetical Case Study #1

- Solar for private entity at select location in California
  - 200,000 kWh/yr electricity usage

On-Site Photovoltaic System	
System Size	133kW (DC)
Capital Cost	$245,700
Annual savings from avoided electricity	$25,600/yr
Financial position after 10 years	Even
Financial payback	10 years
CO_2 offset (local electricity source)	109 tons/yr

RECs	
Cost per REC	$0.03 kWh
Annual cost	$6,000
Financial position after 10 years	($60,000)
Financial position after 20 years	($120,000)
CO_2 offset (national electricity source)	133 tons/yr

Electricity costs from www.eia.gov. PV electric generation from PVWATTs. PV install cost at $6/watt, California incentive of $0.26/kWh for first five years, 30% federal tax credit, and accelerated depreciation based on a 35% federal corporate tax. CO_2 from electric use is non-base load from eGRID. REC offset of CO_2 based on eGRID US blend (1.33 lbs CO_2 per kWh).

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Hypothetical Case Study #2

- Wind for private entity at select location in Illinois
  - 200,000 kWh/yr electricity usage

On-Site Photovoltaic System	
System Size	100kW
Capital Cost	$187,500
Annual savings from electricity minus O&M	$12,600/yr
Financial position after 10 years	($61,500)
Financial payback	15 years
CO_2 offset (local electricity source)	211 tons/yr

RECs	
Cost per REC	$0.03 kWh
Annual cost	$6,000
Financial position after 10 years	($60,000)
Financial position after 20 years	($120,000)
CO_2 offset (national electricity source)	133 tons/yr

Electricity costs from www.eia.gov. Electricity generation based on Northwind 100 specifications. Install costs based on $5,000 per installed kW , $50,000 maximum State rebate, 30% federal tax credit, and accelerated depreciation based on a 35% federal corporate tax rate. CO_2 from electric use is non-base load from eGRID. REC offset of CO_2 based on eGRID US blend (1.33 lbs CO_2 per kWh).

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More Case Studies for Solar

- Solar vs. RECs at more locations – public and private
  - 200,000 kWh/yr electricity usage

Location	Financial Position at 10 years		
	RECs	On-site Solar (Private)	On-site Solar (Public)
California	($60,000)	Even	($284,000)
Colorado	($60,000)	($200,000)	($636,000)
Illinois	($60,000)	($201,000)	($724,000)
Virginia	($60,000)	($276,800)	($800,000)

Electricity costs from www.eia.gov. PV electric generation from PVWATTs. PV install cost at $6/watt and applicable incentives that do not require sale of RECs. Private sector solar includes 30% federal tax credit and accelerated depreciation based on a 35% federal corporate tax.

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More Case Studies for Wind

- Wind vs. RECs at more locations – public and private
  - 200,000 kWh/yr electricity usage

Location	Financial Position at 10 years		
	RECs	On-site Wind (Private)	On-site Wind (Public)
California	($60,000)	+$138,500	($134,000)
Colorado	($60,000)	($103,500)	($336,000)
Illinois	($60,000)	($61,500)	($324,000)
Virginia	($60,000)	($111,500)	($374,000)

Electricity costs from www.eia.gov. Electricity generation based on Northwind 100 specifications and a marginal average wind speed between 5.5 and 6.0 m/s. Install costs based on $5,000 per installed kW and applicable incentives that do not require sale of RECs. O&M costs of $0.025 to $0.03 per kWh. Private sector solar includes 30% federal tax credit and accelerated depreciation based on a 35% federal corporate tax.

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Summary of Cost-Effectiveness

- Federal tax credit and accelerated depreciation greatly benefit the private sector
- On-site renewable energy can be cost-effective in some locations depending on…
  - Tax status of entity
  - Local incentives
  - Local natural resource (especially wind, biomass, etc.)
  - Time frame of remedy and renewable energy system
- On-site renewable energy not cost-effective for the public sector if RECs are to be retained
- On-site renewable energy takes time to pay back. A remedy can change a lot over a 10 to 20 year period.

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Summary of Cost-Effectiveness

- On-site renewable energy benefits from economy of scale...
  - Bigger, more cost-effective systems are typically larger than what is needed for a remedy
  - Installing many small systems is more expensive than installing one large system

- RECs have several advantages…
  - They are scalable… only buy what you need
  - They are not permanent or long lasting… you can change or complete the remedy without affecting a payback period
  - They are not dependent on a solar, wind, or biomass resource at your site

Potential Solution for the Public Sector

- Generate your own RECs
  - Install one large, cost-effective system at a location with optimal resources
    - Near a landfill with good landfill gas to energy resources
    - In an area with good wind resources
  - Sell RECs from this central system to individual remedies in your portfolio
  - Benefit from optimal resources
  - Benefit from economies of scale
  - Keep remedies independent of a large on-site renewable energy system
  - Achieve a reasonable payback

Potential Cost Model

- 1 MW wind system in area with “good” wind resources (7.5 m/s)

Cost Category	Value
Capital Cost	$2,500,000
Electricity generation	3,300,000 kWr/yr
Annual revenue from electricity generation minus O&M	$198,000/yr
Financial position after 10 years	($520,000)
Effective cost of REC at 10 years	$0.016/kWh
Financial payback	13 years
System makes money after 13 years!!!	

Install costs based on $2,500 per installed kW with no incentives. Electricity rate of $0.08/kWh) assumes electricity is used a site through net metering. O&M costs of $0.02 per kWh.

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Putting a Price Tag on Green Remediation

Example Remedies	Electricity Usage (kWh/yr)	% of Remedy CO2e Footprint	% Increase in Cost due to RECs	Significant Affect on Footprint?
P&T system (80 gpm, 500 ug/L of VOCs)	135,000	90%	3%	YES
SVE system (500 cfm, 1,000 lbs per year)	130,000	90%	3%	YES
Electric resistive heating (28,000 cy)	7,000,000	95%	4%	YES
In-Situ Bio or Chemical Oxidation	12,000	<1%	<1%	NO
Monitored Natural Attenuation	0	0%	$0	NO
Excavation/disposal	0	0%	$0	NO

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Conclusions

- On-site renewable energy can be a challenge
  - Cost-effectiveness
  - Identifying a good energy resource
  - Dealing with another project
  - Putting constraints on a remedy
- Don’t sell RECs from your renewable energy system if you want to claim the renewable energy
- RECs are a cost-effective alternative to on-site renewable energy and easy to purchase for any remedy in the country
- Large organizations can benefit from generating their own RECs

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Conclusions

- RECs help put a price tag on the energy and emissions aspects of electricity-intensive remedies
  - Offsetting electricity and emission from electricity is a small fraction of the overall remedy cost

- Cannot or should not use RECs to offset emissions from direct burning of fossil fuels (e.g., diesel, gasoline, etc.)…
  - Can you use RECs to offset footprints from off-site activities that use electricity?
    - Treating water at a POTW
    - Laboratory analysis
    - Some materials manufacturing