Strategy: Conversion pathways

TO \ FROM	electro-magnetic	chemical	thermal	kinetic	electrical	nuclear	gravitational
electro-magnetic		chemillumi-nescence	thermal radiation	accelerating charge phosphor	electromagnetic radiation electrolumi-nescence	gamma reactions nuclear bombs	
chemical	photosynthesis photochemistry	chemical processing	boiling dissociation	dissociation by radiolysis	electrolysis	radiation catalysis ionization	
thermal	solar absorption	combustion	heat exchange	friction	resistance heating	fission fusion	
kinetic	radiometers	metabolism muscles	thermal expansion internal combustion	gears	motors elestrostrictions	radioactivity nuclear bombs	falling objects
electrical	solar cells photoelectricity	fuel cell battery	thermoelectricity thermionics	conventional generator		nuclear batteries	
nuclear	gamma neutron reactions						
gravitational				rising objects			

Source: *Energy: A Beginner's Guide,* Vaclav Smil, 2006.

Pathway: electromagnetic to solar via solar cells

TO \ FROM	electro-magnetic	chemical	thermal	kinetic	electrical	nuclear	gravitational
electro-magnetic		chemillumi-nescence	thermal radiation	accelerating charge phosphor	electromagnetic radiation electrolumi-nescence	gamma reactions nuclear bombs	
chemical	photosynthesis photochemistry	chemical processing	boiling dissociation	dissociation by radiolysis	electrolysis	radiation catalysis ionization	
thermal	solar absorption	combustion	heat exchange	friction	resistance heating	fission fusion	
kinetic	radiometers	metabolism muscles	thermal expansion internal combustion	gears	motors elestrostrictions	radioactivity nuclear bombs	falling objects
electrical	solar cells photoelectricity	fuel cell battery	thermoelectricity thermionics	conventional generator		nuclear batteries	
nuclear	gamma neutron reactions						
gravitational				rising objects			

Source: *Energy: A Beginner's Guide,* Vaclav Smil, 2006.

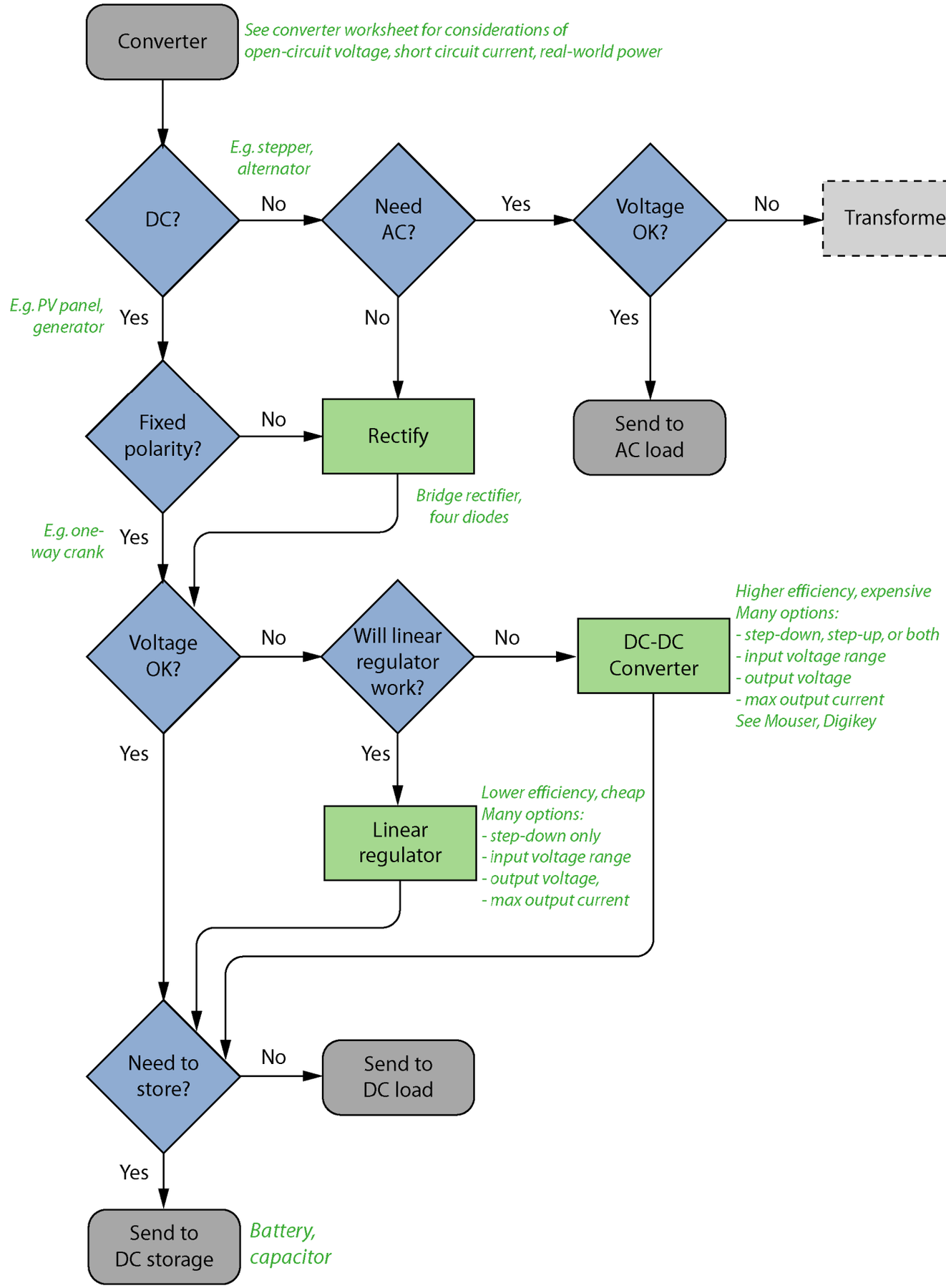
Pathway: kinetic to electrical via generator (induction)

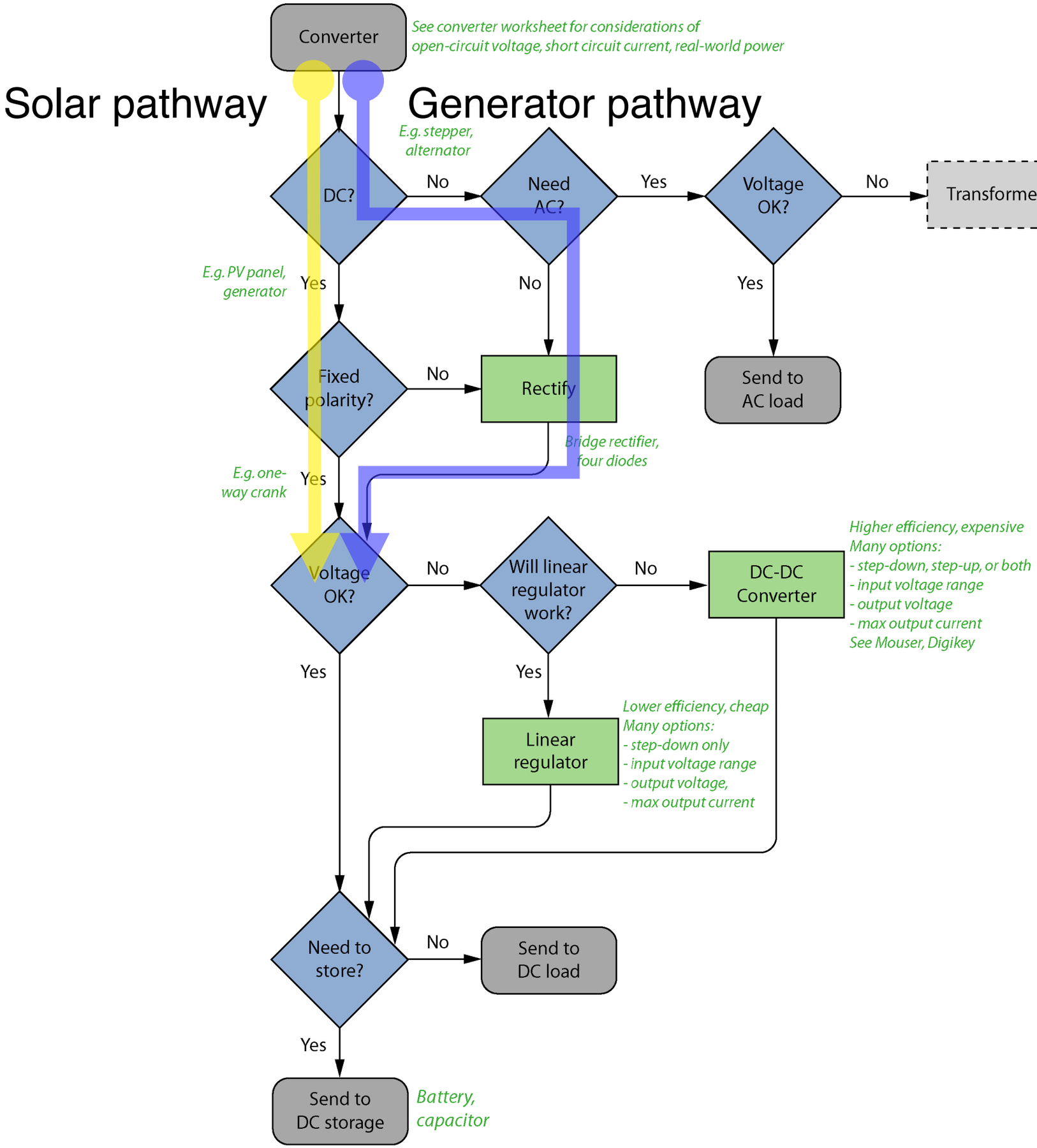
TO \ FROM	electro-magnetic	chemical	thermal	kinetic	electrical	nuclear	gravitational
electro-magnetic		chemillumi-nescence	thermal radiation	accelerating charge phosphor	electromagnetic radiation electrolumi-nescence	gamma reactions nuclear bombs	
chemical	photosynthesis photochemistry	chemical processing	boiling dissociation	dissociation by radiolysis	electrolysis	radiation catalysis ionization	
thermal	solar absorption	combustion	heat exchange	friction	resistance heating	fission fusion	
kinetic	radiometers	metabolism muscles	thermal expansion internal combustion	gears	motors elestrostrictions	radioactivity nuclear bombs	falling objects
electrical	solar cells photoelectricity	fuel cell battery	thermoelectricity thermionics	conventional generator		nuclear batteries	
nuclear	gamma neutron reactions						
gravitational				rising objects			

Source: *Energy: A Beginner's Guide,* Vaclav Smil, 2006.

Pathway: metabolism or falling weights to kinetic to electrical via generator (induction)

Strategy: Conditioning your converter


Converter
See converter worksheet for considerations of open-circuit voltage, short circuit current, real-world power
DC?
E.g. stepper, alternator
No
Need AC?
Yes
Voltage OK?
No
Transformer
E.g. PV panel, generator
Yes
No
Yes
Fixed polarity?
No
Rectify
Send to AC load
Bridge rectifier, four diodes
E.g. one-way crank
Yes
Voltage OK?
No
Will linear regulator work?
No
DC-DC Converter
Higher efficiency, expensive
Many options:
- step-down, step-up, or both
- input voltage range
- output voltage
- max output current
See Mouser, Digikey
Yes
Yes
Linear regulator
Lower efficiency, cheap
Many options:
- step-down only
- input voltage range
- output voltage,
- max output current
Need to store?
No
Send to DC load
Yes
Send to DC storage
Battery, capacitor


Converter
See converter worksheet for considerations of open-circuit voltage, short circuit current, real-world power
Solar pathway
Generator pathway
E.g. stepper, alternator
DC?
No
Need AC?
Yes
Voltage OK?
No
Transformer
E.g. PV panel, generator
Yes
No
Yes
Fixed polarity?
No
Rectify
Send to AC load
Bridge rectifier, four diodes
E.g. one-way crank
Yes
Voltage OK?
No
Will linear regulator work?
No
DC-DC Converter
Higher efficiency, expensive
Many options:
- step-down, step-up, or both
- input voltage range
- output voltage
- max output current
See Mouser, Digikey
Yes
Yes
Linear regulator
Lower efficiency, cheap
Many options:
- step-down only
- input voltage range
- output voltage,
- max output current
Need to store?
No
Send to DC load
Yes
Send to DC storage
Battery, capacitor

Converter

See converter worksheet for considerations of open-circuit voltage, short circuit current, real-world power

DC?

E.g. stepper, alternator

No

Need AC?

Yes

Voltage OK?

No

Transformer

E.g. PV panel, generator

Yes

No

Yes

Fixed polarity?

No

Rectify

Send to AC load

Bridge rectifier, four diodes

E.g. one-way crank

Yes

Voltage OK?

No

Will linear regulator work?

No

DC-DC Converter

Higher efficiency, expensive
Many options:
- step-down, step-up, or both
- input voltage range
- output voltage
- max output current
See Mouser, Digikey

Yes

Yes

Linear regulator

Lower efficiency, cheap
Many options:
- step-down only
- input voltage range
- output voltage,
- max output current

Need to store?

No

Send to DC load

Yes

Send to DC storage

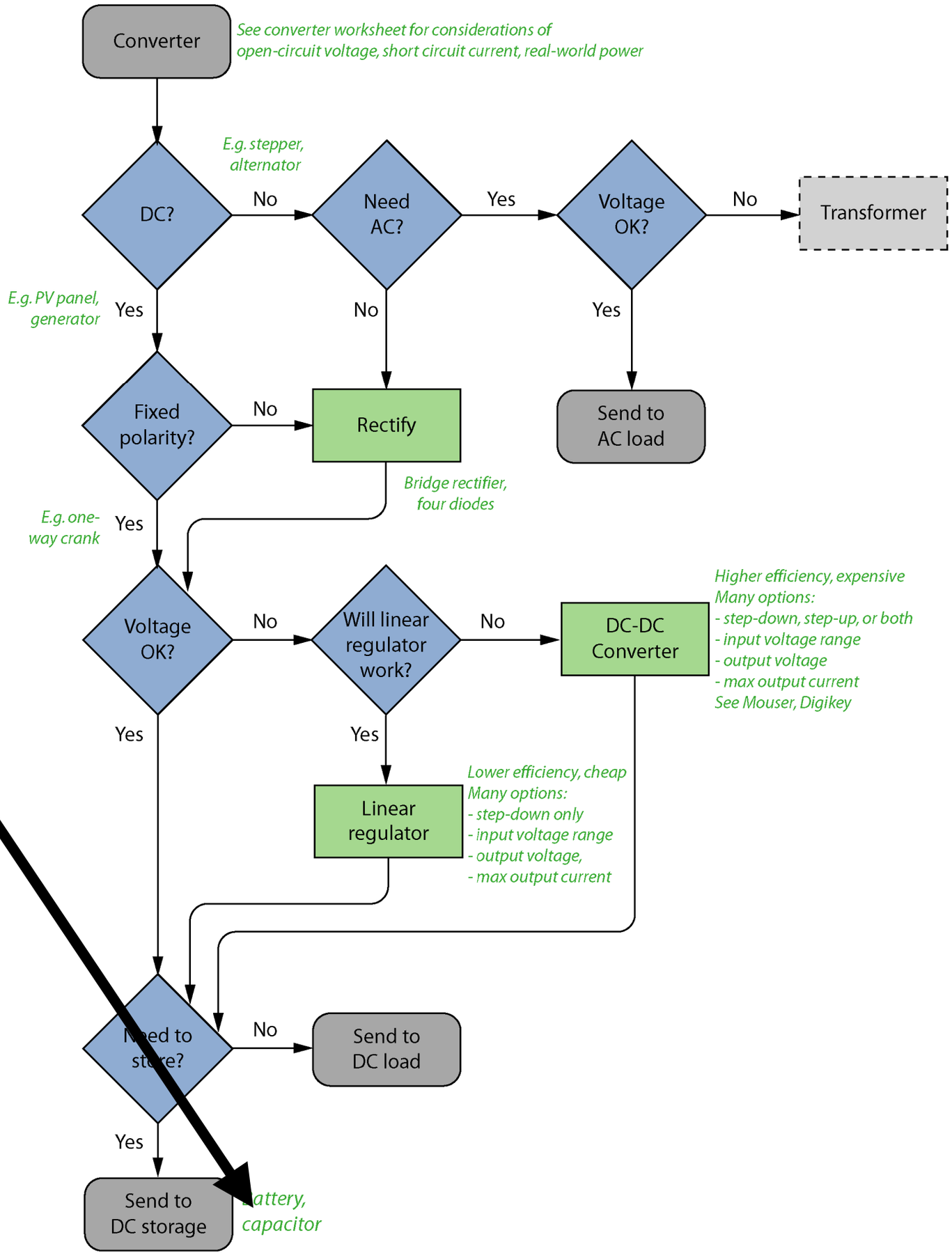
Battery, capacitor

Linear regulator
e.g. LM7805

DC-DC converter
e.g. many from Sparkfun. Mouser, etc.

Smoothing

Storage



Smoothing

.5 * (100 microfarads) * ((5 volts)^2) = 0.00125 joules
More about calculator.

.5 * (3300 microfarads) * ((5 volts)^2) = 0.04125 joules
More about calculator.

.5 * (1 farad) * ((5 volts)^2) = 12.5 joules
More about calculator.

Storage

*

.5 * (60 farad) * ((5 volts)^2) = 750 joules
More about calculator.

Lots of joules

Energy in a capacitor is:

$$1/2\ C * V^2$$

* Would need 2 2.5V caps in series to get 5V.

AC pathway - unlikely in this class